VOL. XII. Nº 4 APRIL 1927

MECCANO MAGAZINE

A TAILLESS AEROPLANE
(see page 230)

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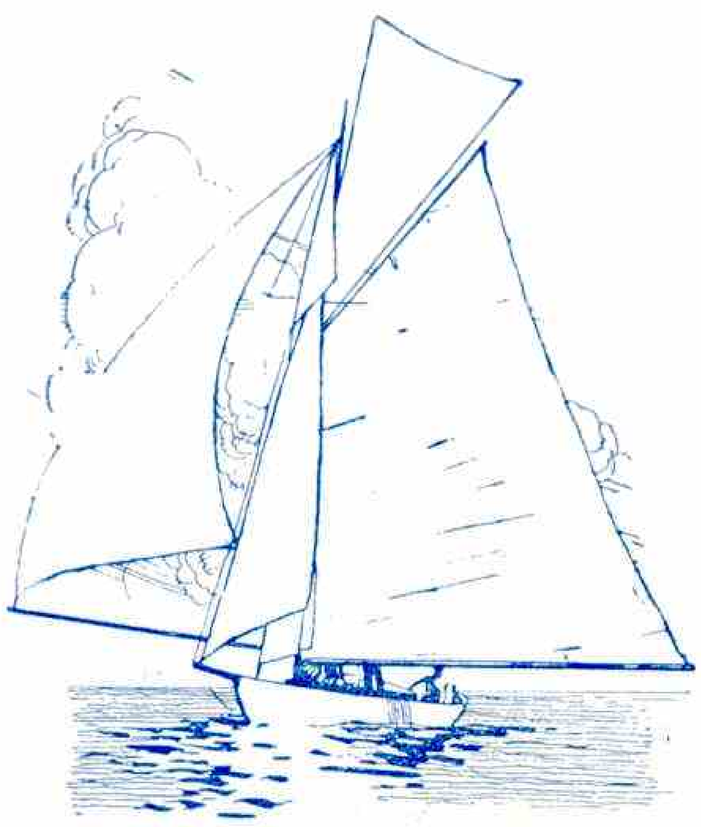

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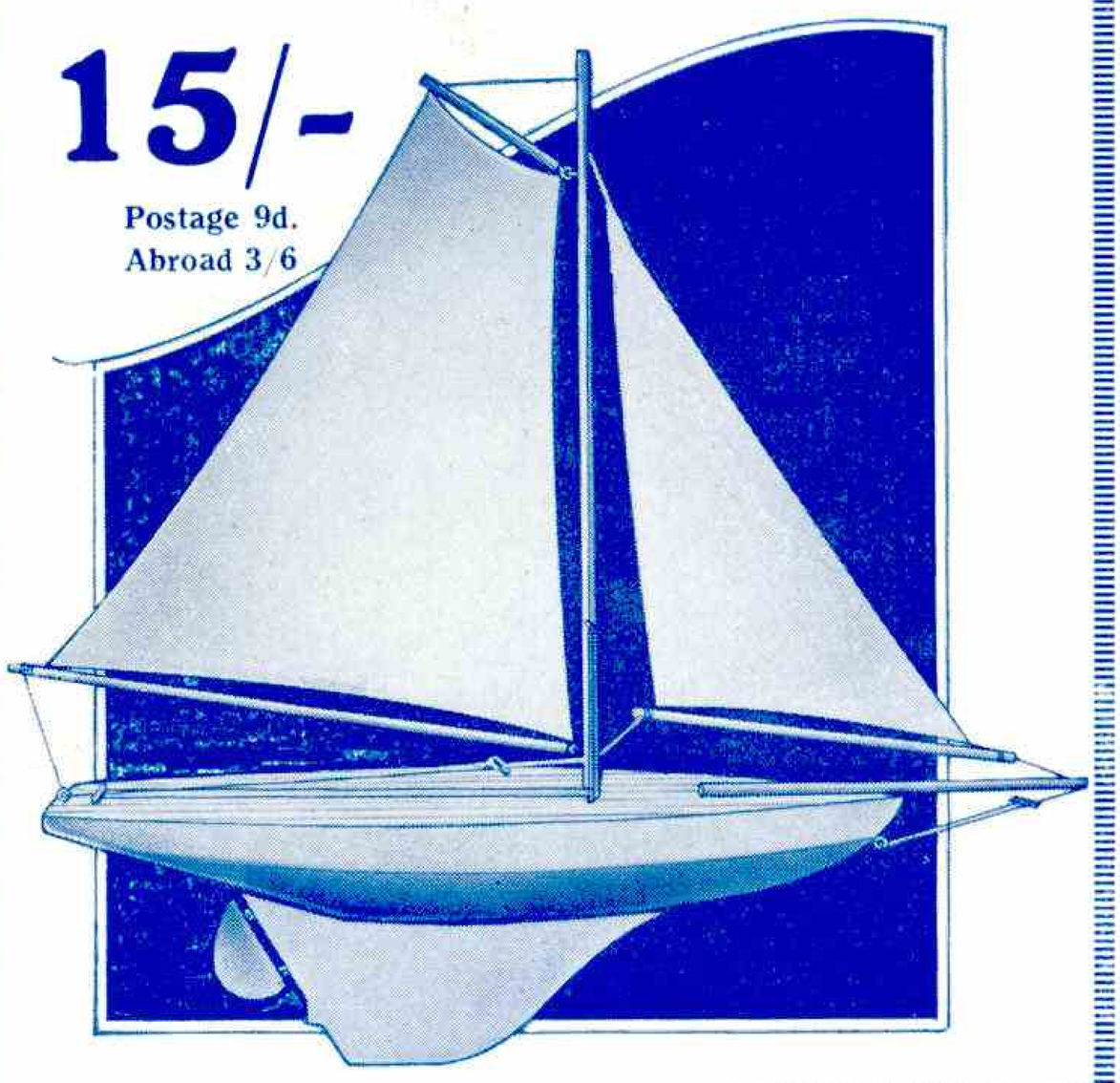

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MECCANO MAGAZINE

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April, 1927

With the Editor

Shortage of Young Engineers

A serious matter, to which attention has recently been drawn, is the noticeable shortage of youths learning the trade of engineering, and qualifying themselves by study as well as by experience for its higher grades and for responsible positions. The shortage applies to all phases of engineering, with the exception of motor and electrical engineering. An authority recently stated that "there are not nearly enough recruits in ship-building, and unless young men are trained in the shops, they will not be available when needed for the ships that are now being built."

There is certainly room for further encouragement and for improvement in the education of young engineers. At present there is a wide gap between even a good school and the university degrees in engineering—and without a degree a student has little or nothing to show that he has been educated in his subject. It seems unlikely, in view of the economies being effected in Government departments, that financial assistance can be given to promising youths, but that certainly would solve the difficulty of the shortage.

There are very many boys who have the making of first-class engineers, but whose parents cannot afford to send them to college or to a university. No one knows this better than I do, for in the course of a year I receive letters from hundreds of readers asking for advice on the question of an engineering career. Many readers, too, send very clever engineering devices for my criticism, and a large number of the models entered in our competitions show considerable ingenuity and promise. Most of these letters, ideas, and models come from boys who would like to be engineers but do not see much prospect of following the profession of their choice, largely owing to financial reasons. It is boys such as these who would benefit from any Government scheme of assistance.

And here let me correct an impression that seems to be at the back of the minds of many of my young friends. There is no "short-cut" to success, either in engineering, editing a magazine, or in any other walk of life. Success is only achieved gradually, and generally after long and painstaking work. Everyone who wants to "get on" must take every opportunity of learning and studying, and generally preparing himself so that when the opportunity comes—as it does come, some day, to every one of us—he can take it and be ready to work in the new sphere that opportunity offers. It is a great thing to be able to recognise opportunity, but an even greater one to "be prepared" and thus to be able to step gradually up the ladder to success when opportunities come.

The point I want to emphasise, however, is that there is no convenient elevator waiting at the foot of the ladder to give a select few—sometimes called the "lucky ones"—a quick trip to the top of the ladder. Everyone who wishes to climb to the top can only do so rung by rung, and by his own efforts.

A Speed Record

As has already been announced in the daily press, a new motor-car speed record is claimed to have been set up by Captain Malcolm Campbell, on a Napier-Campbell driven by a 500 h.p. Napier "Lion" aero-engine. He is now (or at any rate at the time of writing this!) the holder of the official world's record for both the flying kilometre and the flying mile. His mean time for an up and a down run over the one-mile course was recorded as being equivalent to a speed of 174.224 miles an hour.

Commenting on this performance "*The Engineer*," whilst admitting that the speed achieved is remarkable for a machine travelling on wheels, is "not disposed to feel any undue enthusiasm for the fact that it is claimed to be a record." The Editor points out that unless the method adopted for measuring the interval of time (returned as 20.663 seconds) involved the use of refined electrical contacts, or other means analogous to those employed for measuring the velocity of projectiles, the second and third place of decimals in the figure—and very probably even the first—are open to suspicion.

The Vagaries of a Stop Watch

In most of these electrical recording apparatus the car makes or breaks a contact when passing the post, and a stop watch is thereby electrically started or stopped. But in the exceedingly high speeds that now have to be attained to put up a record, the fraction that either makes or fails to make a new record is so infinitesimal that no method making use of a stop watch could give a measure of time with sufficient accuracy. This figure in the case in point, is carried to the third place of decimals.

The ordinary fifth-second stop watch has a balance wheel that makes five oscillations a second, and the position of the hand has no significance except at the exact fifth-second marks. A stop watch capable of being read to the thousandth part of a second would require to have a balance wheel making a thousand oscillations per second.

As "*The Engineer*" points out, the previous speed record was held by the late Mr. Parry Thomas, with a mean mile speed of, officially, 170.624 miles an hour. Captain Campbell's feat consists of doing the mile in 0.436 second less than Mr. Thomas. That figure speaks for itself, as regards both the merits of the achievement and the accuracy that is required in the means of observing the time interval for the runs.

The Holder of the "Blue Riband"

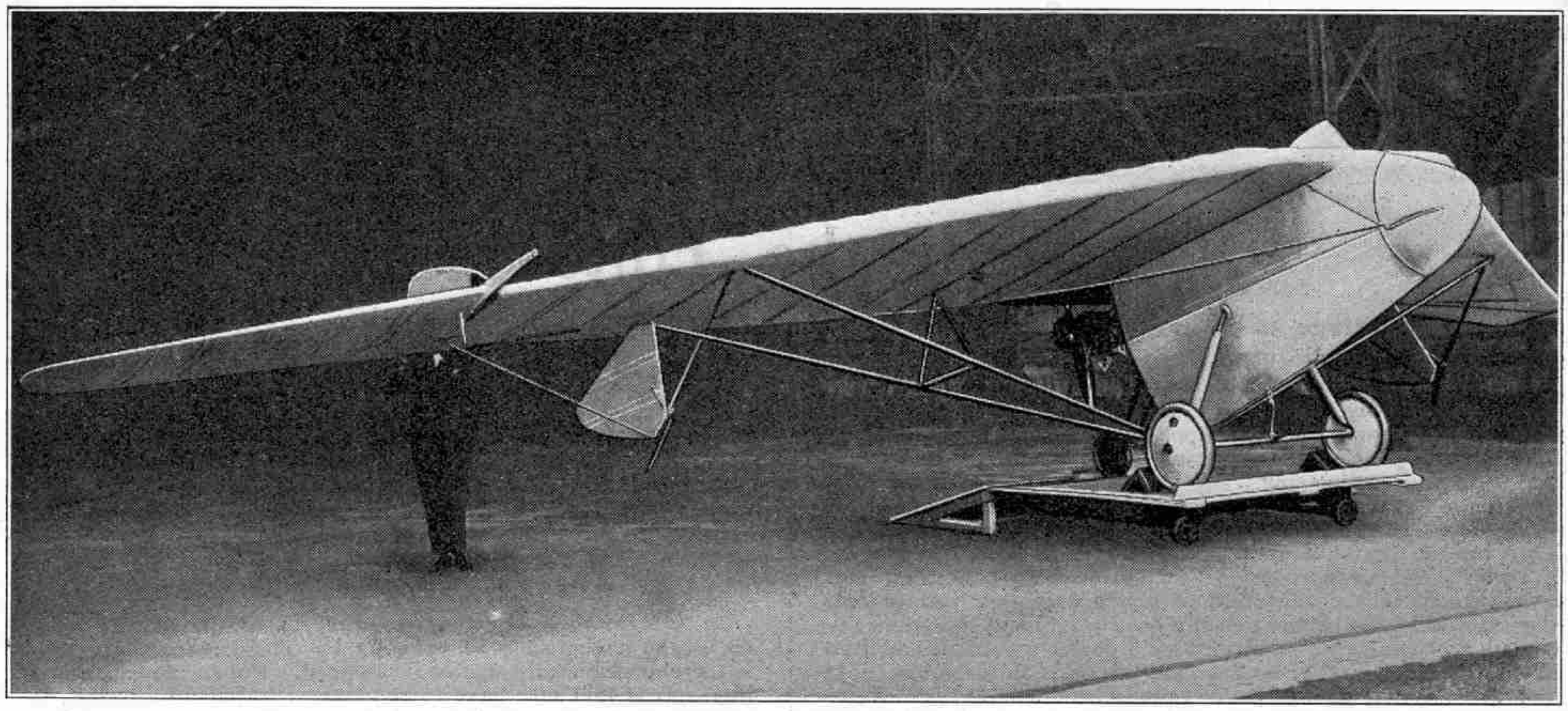
The Cunard liner "*Mauretania*," having been overhauled and reconditioned at Liverpool, was recently subjected to a speed trial in the English Channel. For two hours a speed of 26 knots was easily maintained—a result that seems to show this fine vessel to be possessed of as good a speed as ever. The "*Mauretania*" holds the speed record for the Atlantic crossing, having crossed from Cherbourg to New York in 5 days 3 hrs. 20 mins. and from her recent trials it would seem that to wrest from her the "blue riband" of the Atlantic will be a difficult, if not an impossible task for any ship.

The main work done during the overhaul consists of improvements in the passenger and public room accommodation, and the re-planning of 100 state rooms. Most of this work was carried out by the repair department of the Cunard Company, but the overhaul of the main turbines, auxiliary machinery and boilers was carried out by a firm of engineers, who also carried out the new electrical and plumbing work required in the ship. The high-pressure and low-pressure turbines were opened up and inspected and the boilers were cleaned. Other work included the fitting of two new propellers and one tail shaft, while a new 670-ton oil fuel bunker was added, bringing the total oil fuel carrying capacity of the ship to over 7,000 tons.

After completing her first round trip the "*Mauretania*" will undertake a cruise to the Mediterranean before taking up her scheduled service between Southampton and New York.

The Conquest of the Air

XXIV. The "Pterodactyl"—A Tail-less Monoplane



Captain Hill's Tail-less Monoplane

A CONSIDERABLE number of the flying accidents that occur each year must be attributable to loss of control by the pilot. It was the possibility of being able to eliminate such casualties that caused Capt. G. T. R. Hill to attempt the design of a machine that would be proof against errors in piloting. Working entirely unaided for some time, he later received valuable assistance from the Aeronautical Research Committee, which enabled further investigation to be carried out at the Royal Aircraft Establishment at Farnborough.

Finally, after three years' steady research and experiment, the much talked of "*Pterodactyl*" has been evolved. The machine was first tested as a glider in December 1924, and was so successful that it was converted into a light aeroplane, a 30 h.p. Bristol "Cherub" engine being fitted. The first flight on this new craft was carried out in November 1925.

We do not propose in this article to go into all the theoretical and technical principles involved in Capt. Hill's machine. It will be sufficient to describe briefly its design and to deal with the points in which it differs from the conventional aeroplane.

Origin of the Name

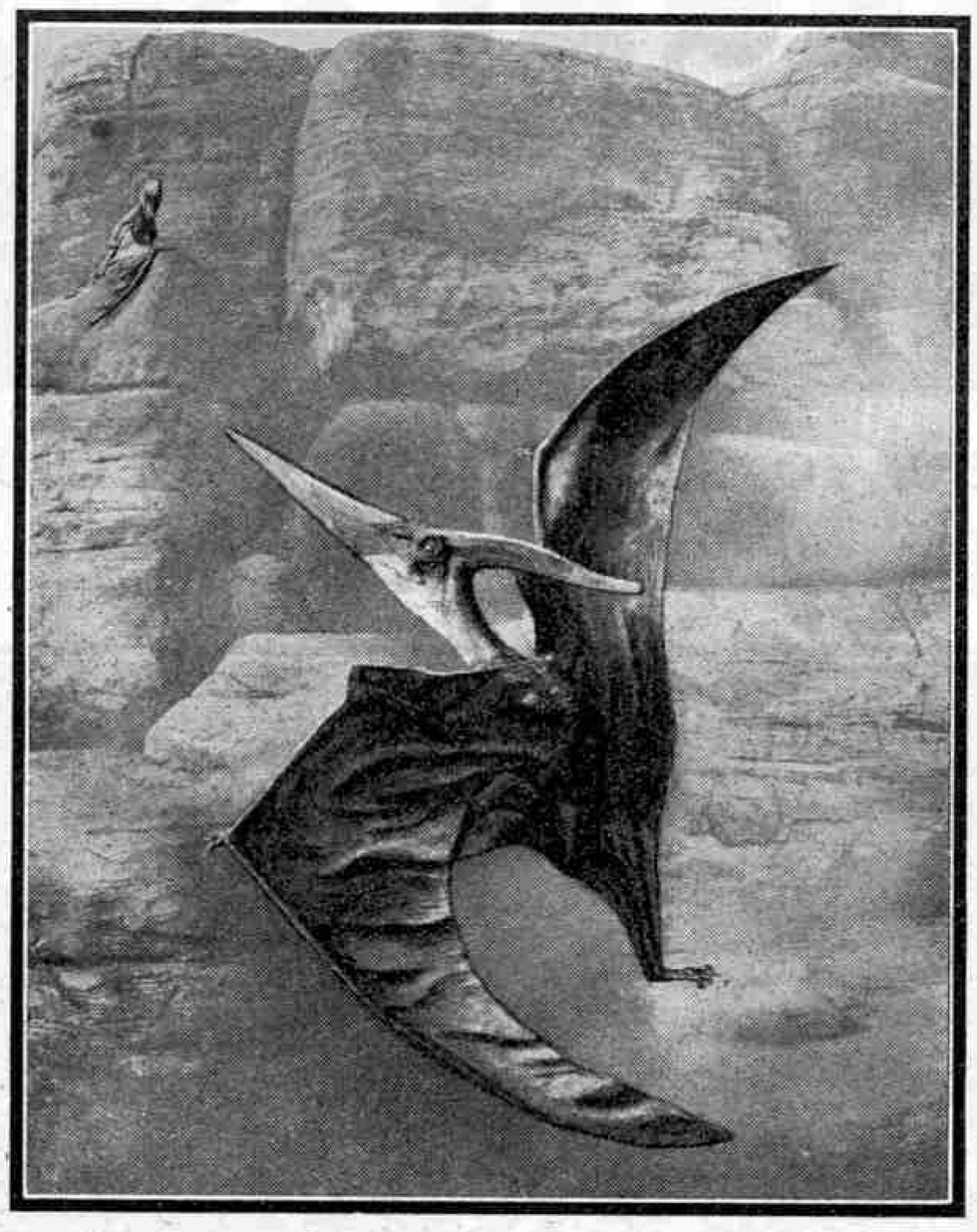
In passing it should be mentioned that the peculiar name of the machine gives a clue to its appearance, Capt. Hill choosing "*Pterodactyl*" on account of the machine's striking resemblance to a type of flying lizard that lived in prehistoric times. Fairy-tales contain numerous references to griffins and flying dragons, and it is generally believed that such creatures as these never actually existed. If this is so, however, then the Pterodactyl came very close to being the "winged-dragon" of our legends.

By looking closely at the illustration on the next page it will be seen that these creatures had fingers on their wings, and this is how they get their name Pterodactyl, which comes from the Greek *Pteron*, "a wing," and *dacktylas*, "a finger." They were able to perch on trees, hang against rocks, and yet could also stand firmly on the ground and crawl on all fours like an animal or hop on their hind legs as birds do! Pterodactyls varied greatly in size, some being no larger than sparrows, and others being veritable giants with a wing-spread of over 20 ft.

Previous articles in the "Conquest of the Air" series have appeared as under:—

1.	The Lympne Trial for Light Monoplanes	Mar.	1925
2.	Beardmore "Wee Bee I."	Apl.	"
3.	Super-Seaplanes for U.S. Navy	May	"
4.	Argentine Airman's Attempt to Circle the Earth	June	"
5.	Parnall "Pixie III."	July	"
6.	De Havilland "Moth"	Aug.	"
7.	Beardmore-Rohrbach All-Metal Flying Boat	Oct.	"
8.	Fokker C.V. Scout	Nov.	"
9.	Vickers "Vimy" Ambulance	Dec.	"
10.	The Cierva Auto-Giro Flying Machine	Jan.	1926
11.	Boulton "Bugle"	Feb.	"
12.	The Flight from London to the Cape	Mar.	1926
13.	Light Aeroplane Clubs	Apl.	"
14.	D.H. 54 (de Havilland) "Highclere"	May	"
15.	Vickers (Rolls-Royce) "Vanguard"	June	"
16.	De Havilland "Hercules"	Aug.	"
17.	Handley Page "Hampstead"	Sept.	"
18.	The Gloster "Gamecock"	Oct.	"
19.	The Parnall "Plover"	Nov.	"
20.	Sir Alan Cobham's Flight to Australia	Dec.	"
21.	"Southampton" Supermarine Flying Boat	Jan.	1927
22.	Cairo—Karachi Air Route	Feb.	"
23.	Two Famous French Aeroplanes—"Goliath" and "Jabiru"	Mar.	"

from tip to tip. They all had bird-like heads and very sharp teeth, but no feathers, leathery membranes stretching from the front limbs to the back limbs. We know that they were able to fly because their fossilised remains have been found in places where they must have been far out to sea when they sank into the waters of the pre-historic ocean. Here they were covered with sand and mud, became fossilised, and were subsequently found embedded in the hard rock formed from the sand and mud into which they fell.



The Pterodactyl, or "Flying Dragon" of prehistoric times

Many Novel Features

To return now to the tail-less monoplane. The wing of the machine is of fairly normal construction, but instead of being spread at right-angles to the fuselage it is swept back so that the front edge tapers from the fuselage at an angle of 59 degrees. The trailing or rear edge is set at an angle of 76 degrees, so that the width of the plane narrows as it recedes from the fuselage, which is short. The "Cherub" engine is fitted in the back of the fuselage and drives a "pusher" propeller.

The undercarriage legs lead through the sides of the fuselage, in the body of which the shock absorbers are placed, while at the back end of the fuselage a small wheel, mounted very similarly to the front fork of a bicycle wheel, is fitted to complete the landing gear. For steering while taxi-ing on the ground this rear wheel is geared to the rudder bars, and by an ingenious device it may be locked to act as a brake.

The machine incorporates many novel features that may be said to ensure that each control apparatus performs its own function and that alone. To make this point clear it may be explained that the controllers of an ordinary aeroplane are the ailerons, the rudder and the elevators. These, in operation, cause the movements known respectively as banking, yawing and pitching, and in a normal flight on a level keel each probably functions entirely independently of the others. When the machine is manœuvred in anything approaching a violent manner, however, their tendency is to forsake their own duties and to perform those of the other units until, when the "stalling" position is reached, they all refuse to function and the machine tends to get out of control.

This difficulty has been overcome in the "*Pterodactyl,*" which has practically no "stalling" angle, by the introduction of what are termed "controllers," really pivoted wing tips, arranged in such a manner that, no matter what may be the angle of the aeroplane itself, they always are lying trailing in the wind. Floating in the wind would perhaps describe their position even better. Their main advantage over ordinary ailerons lies in the fact that as the stalling point—in so far as the machine may be said to have a stalling point—is approached, they are still available for control purposes as they lie in what may be termed a "neutral" position.

These controllers when operated together act as elevators and when used differentially as ailerons.

Rudders Act as Air-Brakes

The rudders present a specially novel feature. They are mounted below the wing, one on each side, and in their normal position they trail freely in the wind. When it is desired to turn, however, say to the right, the right rudder is deflected across the line of flight and turns the machine to the right. The left rudder remains trailing and offers no resistance. In a similar manner, when turning to the left the left rudder is deflected and the right swings free.

Not content with this, however, Capt. Hill installed a special control that operates both rudders simultaneously in such a manner that they actually constitute an air-brake. This is achieved by swinging the rear edge of the right rudder out to the right and moving the left rudder outward also. The effect of this air-brake is to double the machine's resistance to the air, and as a consequence the gliding angle is made considerably steeper.

The greatest feature of all, however, is one that of itself makes the machine worth developing to the last degree. It has been found possible to bring the machine from the stalled to the unstalled condition without recourse to diving. Thus it is possible to make the change without losing height, a very valuable property when operating near the ground.

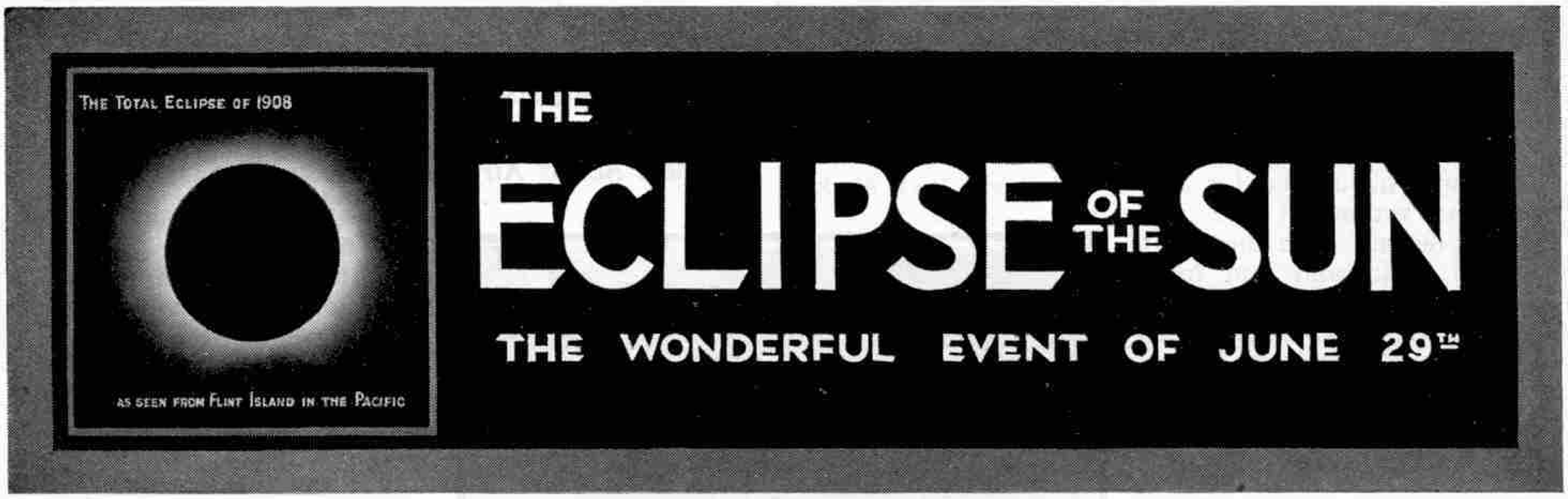
The dimensions of the machine are interesting for they are in striking contrast to those of the orthodox aeroplane and, in addition, Capt. Hill is confident that his machine can be built with a smaller percentage of structure weight than any known type of machine.

The body of the "*Pterodactyl*" is of light balsa plywood and the overall span is 45 ft. The area of the main plane is 223 sq. ft., of the controllers 55 sq. ft., and of the rudders 13 sq. ft. The unloaded weight varies from 444 lb. to 458 lb. according to the size of the undercarriage wheels. The weight of petrol and oil when fully loaded is 30 lb. and the total loaded weight without the pilot 488 lb. The speed range is from 30 to 70 m.p.h.

First Appearance Causes Mirth

The "*Pterodactyl*" made its first public flight at the R.A.F. display at Hendon aerodrome in July last. Piloted by Flight-Lieutenant Chick, it took part in the aerial parade before the King, and although the parade consisted of sixteen machines, representative of newest aeronautical practice, the "*Pterodactyl's*" only serious rival in popular attention was the Cierva "*Auto-Giro.*"

These two machines, weirdly wonderful (*Cont. on page* 359)



(2). WHERE TO GO AND WHAT TO LOOK FOR

IN last month's article the cause of eclipses was fully explained, and in this article we are to deal with the eclipse that particularly interests readers in Great Britain. As is already well known, this occurs 29th June next, and the path of totality passes from North Wales across England, Norway and the Arctic Ocean into Siberia, as shown on the map on page 195 of the March *"M.M."* The portion of the track that crosses England and Wales is shown on a large scale on the map on the next page.

It will be seen from this map that the central line of the track of the shadow practically passes through Southport and Hartlepool, and the lines representing the edges of the shadow are about 15 miles on either side of the central line. Readers living in places not marked will be able to judge quite easily whether they will see the eclipse in its complete form, or only as a partial eclipse, if they remain at home, and suitable arrangements may then be made for the great event.

The crescent-shaped Sun images seen under trees at the time of a total eclipse

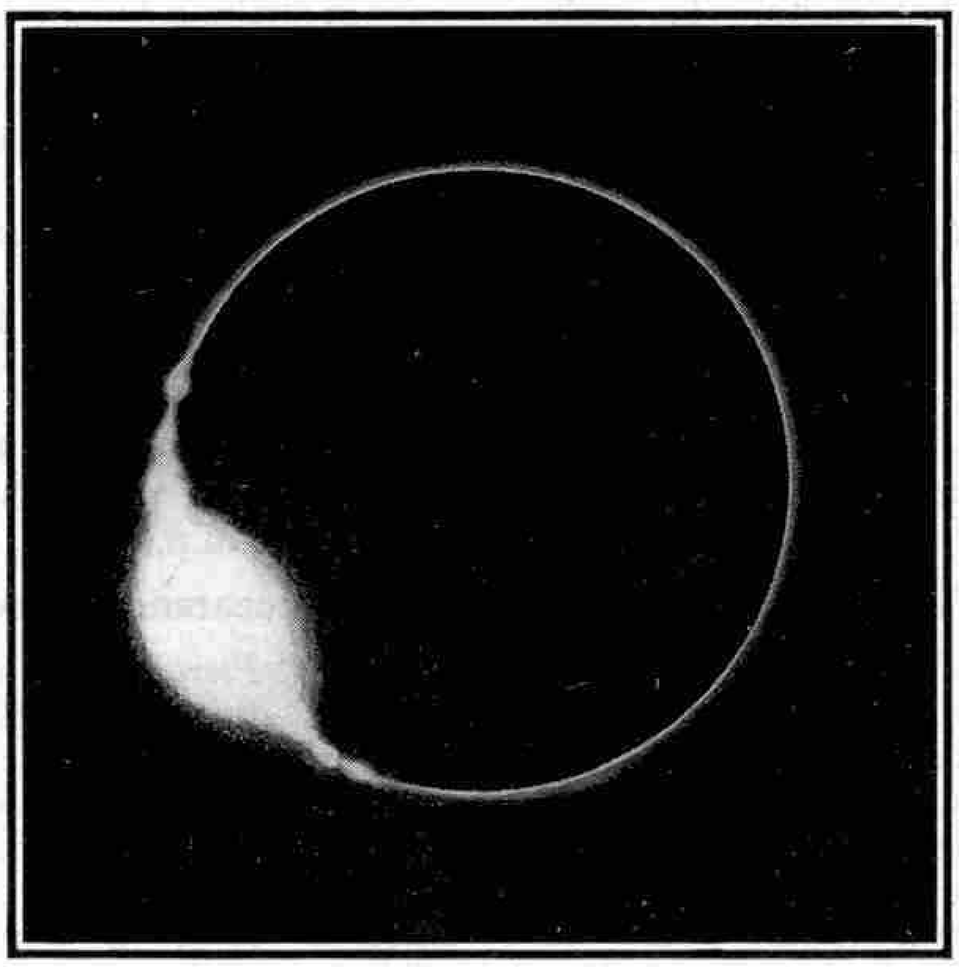
Best Places from which to see Eclipse

Anyone wishing to see the eclipse as a total one will do well to follow the advice given last month—to get as near the central line as possible. An additional reason to the one already given for this is that totality is slightly longer at places situated on the central line, and for this reason astronomers are making places such as Southport and Giggleswick their centres for observations next June.

At Southport the total phase of the eclipse will commence at 24 minutes past 6, summer time, and the sun will be totally invisible for just over 23 seconds. At the spot near Hartlepool, where the central line leaves England, totality will be about a minute later and will last for 24 seconds. The time of complete eclipse is not very great at any point on the path of totality, as the eclipse happens when the length of the Moon's shadow is very little greater than the distance between the Moon and the Earth.

On an average, totality at solar eclipses lasts for just over three minutes, but on this occasion even in the middle of the track off the north coast of the inhospitable island of Nova Zembla, the Sun will be completely hidden for 50 seconds only. It is interesting to note that the series of eclipses, the tracks of which are represented by the lines south of the equator on the map published last month, are all distinguished by long periods of totality. Those of 1901 and 1919 had total phases six-and-a-half minutes in length, while the great eclipses of 1955 and 1973 will have total phases of over seven minutes, almost the maximum possible period.

For places removed from the central line, but still within the track, the total phase will not be so long. The centre of the city of Liverpool, for instance, is just within the calculated track, and here the Sun will remain invisible for eighteen seconds, while at Durham, on the eastern side of England, the duration of totality will be twelve seconds only.



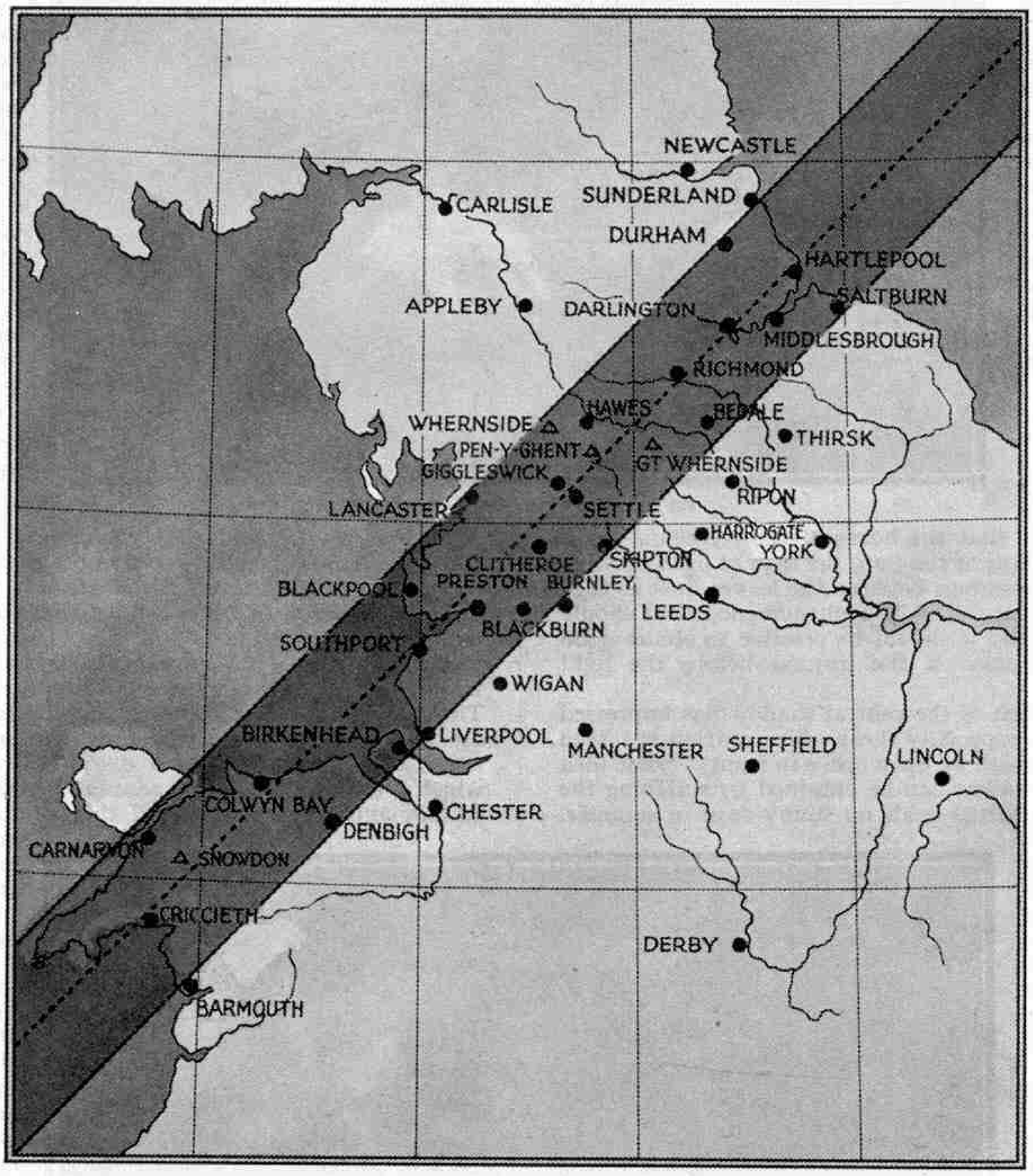
The diamond ring effect and Baily's Beads are both visible in this drawing of the eclipse of January 1925

Any description of what is to be seen next June will fall naturally into two parts, the first dealing with the partial eclipse, and the second with the phenomena visible only on the occasion of a total eclipse.

While the most impressive scenes will be witnessed only by those readers who take up a position on the line of totality, there will be no lack of interesting things to be seen anywhere in the British Isles. The penumbra of the Moon's shadow covers a much larger area of the Earth's surface than the central or umbral portion, as illustrated in Fig. 1 in the article of last month, and in places where the penumbral shadow falls the eclipse will appear partial. This will be the case over the whole of the British Isles—except, of course, that portion where the eclipse is total—and a very considerable area on either side of the track of totality, so that a partial eclipse will be seen from places in Europe and Northern Asia, and also from the Polar regions and the extreme north of America on the other side of the track.

Many readers no doubt will remember the partial eclipse of the Sun that was visible in this country in April 1921, when about five-sixths of the Sun's disc was hidden behind the Moon. On that occasion little interest was taken beforehand by most people, as there was an inclination to regard a partial eclipse as a very minor affair. The weird changes in light and the perceptible chill that was experienced as the eclipse progressed forced the event on the attention of all, however, so that there was a great last-minute search for blue or smoked glass to enable the Sun to be examined with safety.

The effects of the coming eclipse in places where it is partial will be even more impressive, as a still greater proportion of the light and heat of the Sun will be cut off. At Greenwich, for instance, 96 per cent. of the Sun's disc will be invisible at twenty minutes past six in the morning, so that roughly one twenty-fifth only of the usual amount of light and heat will be received in London. As we go further north-west toward the track of totality, the proportion of the Sun's disc obscured by the Moon increases to 97 per cent. at Oxford, and finally to 100 per cent. at the southern limit of the path of totality. On the north-western side of the path the eclipse will be almost total at Newcastle, and at Edinburgh and Glasgow the portions of the Sun eclipsed will be 98 per cent. and 97 per cent. respectively. In Ireland 97 per cent. is the proportion that will be covered at Dublin and at places in Ulster the proportion is slightly less.



Our Map shows the line of totality for the coming eclipse. From all places in the shaded band a total eclipse will be visible. Outside the shaded lines the event will only be seen as a partial eclipse

The Most Wonderful Spectacle in Nature

A total eclipse is perhaps Nature's most wonderful spectacle. As the dark body of the Moon gradually makes its way across the brilliant Sun, changes come slowly at first. An uneasy feeling steals over everything, owing to the slow diminution of light and heat, and as the time of the actual complete eclipse comes nearer, events proceed more rapidly. The sky becomes grey or dull purple. Birds are disturbed by the apparent approach of night, and seek their night quarters somewhat reluctantly as if not quite convinced that it really is night. Bats may appear, and even night-closing flowers, such as the scarlet pimpernel and the African mimosa, close their petals. Mysterious shadow bands sweep over the face of the Earth, the wind drops, and everywhere there is a peculiar silence. The onlookers are finally plunged into chilly night by the on-rush of the central shadow, which advances with almost terrifying speed.

In the sky for a few moments all that is visible is a black disc where the Sun was, with a rosy glow skirting the edge of the Moon and the silvery light of the corona spreading out into space. Possibly some bright stars are visible too, although this is not always the case. Then suddenly the tension is relieved by an arrow of sunlight, and as the Moon's black disc passes over, the Earth comes to life once more.

Of the overpowering effects of a total eclipse there is ample evidence. The English astronomer Baily, who observed the great eclipse of 1842 at Pavia in Italy, wrote that he was "astounded by a tremendous burst of applause from the streets below, and at the same time electrified by the sight of one of the most brilliant and splendid phenomena that can well be imagined," this being the sudden appearance of the corona. Other astronomers have given similar descriptions of the effect on them, and the most hardened of scientists is quite able to understand and sympathise with the ignorant savage who either hides himself in fear or beats tom-toms to scare away the dragon that threatens to devour the life-giving Sun. The remarkable spectacle is so vivid and awe-inspiring that for the moment all earthly things seem small and far away, an impression that is never wholly lost.

"Eclipse Postponed"

But there is another side to this story, as the experience of 1887 shows. Complete preparations were made in that year for observations of an eclipse that was to have a total phase of nearly four minutes, the track passing from Berlin along the route of the Siberian railway to Japan. An imposing array of astronomers from all nations, equipped with costly apparatus, assembled at points along the line at great expense in time and money, but—the day was cloudy and general failure was reported! In Berlin a notice was posted up by some humorist—certainly not an astronomer—to the effect that "the eclipse is postponed on account of the weather!"

Only one man really saw the eclipse and his good fortune was thrust upon him. He was Mendeleef, a well-known Russian scientist, who had made arrangements to rise in a balloon above any possible clouds. Somehow the balloonist was left behind and Mendeleef unexpectedly shot up into space to a height of over two miles, and from this unfamiliar conveyance he enjoyed in solitary glory a fine and uninterrupted view of the marvellous corona!

Wind Made Visible

A full and complete description of the phenomena visible during an eclipse would require much more space than is available. For the present, therefore, we will deal only with the many striking features that may be observed by any reader.

The first of these phenomena to be observed will be the formation of wavy shadow bands that can be seen just before and after totality at most eclipses. These vary considerably, sometimes being only one inch in width and 10 or 12 inches apart, while at other times they are as much as eight inches in width with a distance between them of several feet.

They are always in movement, but their speed varies from that of a man walking to that of an express train. This low speed as compared with that of the shadow of the Moon—over 1,000 miles per hour as we have seen—proves that these bands are due to something in our atmosphere.

What actually happens is that the air cools unevenly when the eclipsing shadow creeps over, and this uneven cooling causes refraction or bending of the light rays passing through it, with the formation of shadow bands. In general their direction appears to be the same as that of the wind and they may almost be described as wind made visible! The streaky appearance of air over

a fire or hot plate is an example of the same thing, and when the rays from a source of light pass across air in this condition flickering shadows exactly similar to the shadow bands of an eclipse may be seen on any suitable surface, such as a wall.

Sun Images under Trees

The coming eclipse occurs at a time when the leaves are well developed, and if the weather is good, images of the eclipsed Sun may be seen on the ground under trees. Moving circles of light may often be seen in the shade of large trees on sunny days in summer, and if there is a high wind these circles move about in sympathy with the swaying of the leaves above them. They are really images of the Sun produced in the same way as in a pin-hole camera, the openings between the leaves acting as the pin-holes. The size of the images depend on the height of the foliage above the ground, a height of ten feet resulting in the formation of circles about one inch in diameter.

During the partial stages of an eclipse the circles become crescents, as shown in the illustration on p. 292 and they disappear during totality. It is found, too, that the horns of the crescents are in the opposite direction to those of the Sun, the rays of light crossing as they pass through the openings between the leaves, just as they do in passing through a lens. This is a phenomenon that should specially be watched for, and it should be possible to secure good photographs of the crescents on the ground before the light becomes too dim.

The speed of the approach of the central shadow has impressed many practised observers, especially those whose station has been on a hill or a tall building with an open space in front. Some idea of this movement of the shadow can be obtained by watching the passage of cloud shadows across fields on sunny days in summer. The effect in this case, however, is only a very feeble imitation of that produced by the mighty shadow of the Moon, sometimes over 100 miles in diameter, that sweeps over the Earth with a speed of more than 1,000 miles an hour.

One astronomer, who saw this shadow rushing over the Italian plains from a high building at Turin, said that he felt giddy for a moment, as if the building under him bowed on the side of the coming eclipse. Another observer said that he listened involuntarily for the rushing noise of a mighty wind when the edge of the shadow swept over him, and generally the coming of the shadow appears to be almost the most impressive feature of the eclipse. Every effort, therefore, should be made by readers to find a position from which to see this imposing effect.

An Eruptive Prominence (see below)

This and the above photograph show an eruptive prominence, photographed at the Yerkes Observatory on 25th March, 1910. In the lower photograph the prominence is shown detached from the solar disc, leaping away into space. A quiescent prominence is seen in both photographs on the extreme left

Curious Phenomenon to be Looked For

At the moment when the Moon's shadow has covered all but the very last bit of the Sun the rim of the latter changes with startling suddenness into a string of eight or ten round bright spots, an effect that has led watchers to exclaim that the Sun was breaking in pieces! The first record of this was made by Halley in 1715, but a more complete description was given by Baily, the astronomer already referred to, who saw the spots well during an annular eclipse in Scotland in 1836. He described them on that occasion as a row of "lucid points like a string of bright beads," and ever since they have been known as Baily's Beads. They can be seen again as the Moon's shadow leaves the Sun on the opposite side, when they appear finally to run together like drops of water. These spots have been photographed.

The explanation of the "Beads" is probably an optical one. Any brilliant object has a tendency to appear larger than it really is, an illusion known as irradiation, and in this case the illusion is possibly helped by the irregular outline of the Moon.

During the American eclipse of January 1925, an appearance that came to be described as "the Diamond Ring" was visible instead of the beads, the cause being similar. Just before and just after totality, the Moon's disc was surrounded by the faint orange glow of the inner corona, and at the point where a minute portion of the Sun's disc was uncovered there was a dazzling spot of light, the whole giving the effect that suggested the name. The drawing of the eclipse on p. 292 shows this effect well, in addition to the phenomenon of Baily's Beads.

The Greatest Mystery of the Eclipse

It is during the few seconds of total eclipse that astronomers become most interested, when the famous corona, perhaps the greatest of eclipse mysteries, is visible. During those flying seconds they are busily engaged on a programme of observations that has been planned months beforehand.

A vague idea of the appearance of the corona may be obtained by looking at a bright street lamp through a steamy window. The rays of light that appear to radiate from the lamp in this case are more regular, however, than those seen in the corona. It is not a mere halo, but has a distinct structure, the discovery of which is due to the method adopted by observers in the olden days of bandaging their eyes until the corona became visible. They are able to form a better judgment of the colour and shape by thus shielding their eyes from the strong light of the Sun itself.

Three portions of the corona are usually distinguished. At the poles of the Sun are seen bundles of straight rays separated by narrow dark lines, and these become curved as their point of origin is moved away from the poles. Then there is a glow about the equator of the Sun that usually appears flesh-white but is often tinted with orange, and finally, the rarest and most impressive sight of all, long silvery streamers extending on either side of the Sun for millions of miles into space, resembling enormous wings. These streamers may have been seen by ancient civilised people, as practically all representations of the Sun in the sculpture of the Egyptians, the Assyrians, and other Sun-worshipping nations of the east show it as a winged disc. Many drawings of the corona during the past century strongly emphasise this wing-like structure, the illustration of the eclipse of 1878 on page 197 of the March *"M.M."* being a good example.

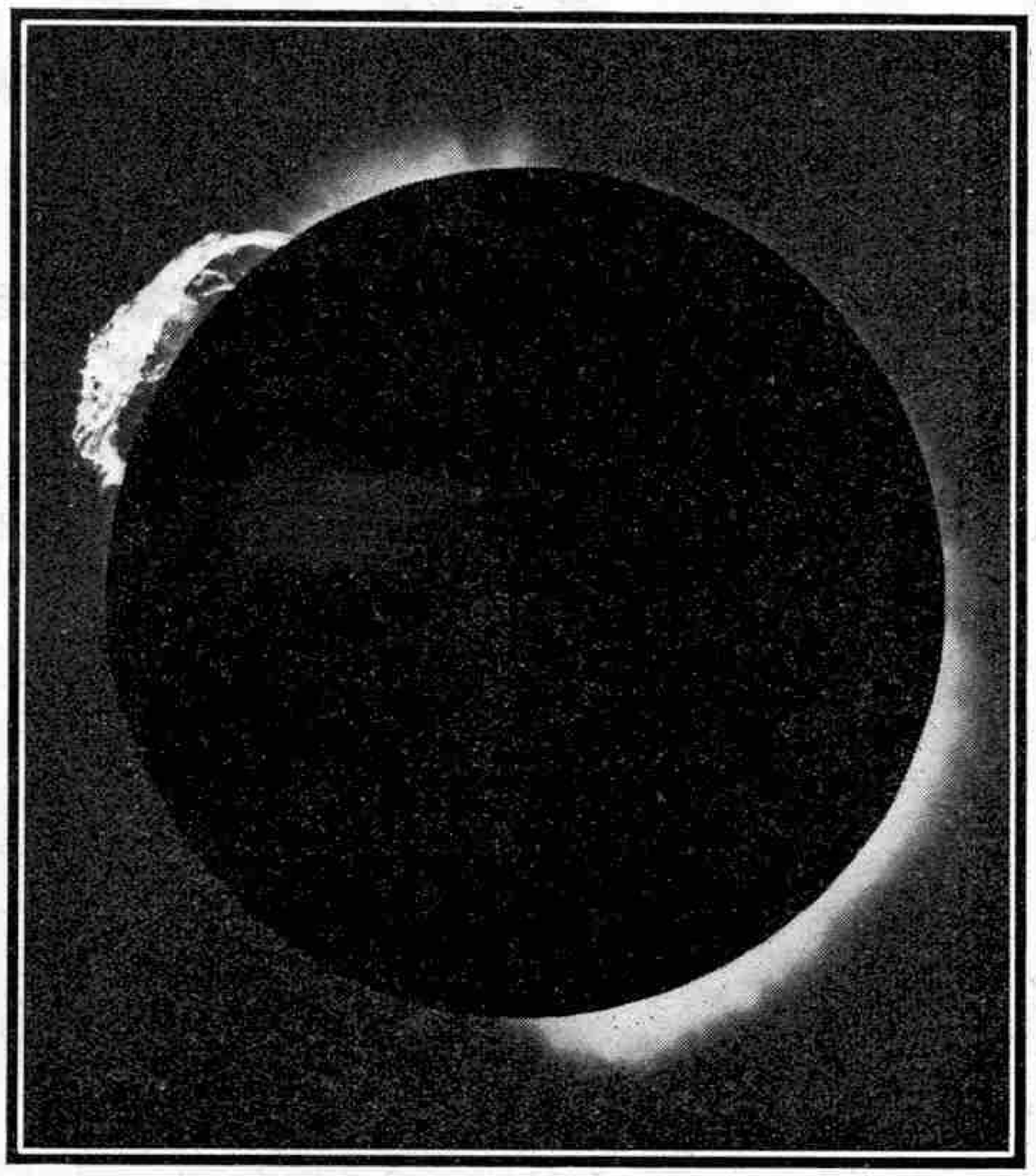
One spectacle that we should all enjoy would be a revolving corona! Don Antonio de Ulloa, the Spanish explorer, writing of the eclipse in 1778, said that the corona "seemed to have a rapid circular motion, like an ignited wing in a firework turning on its centre." A previous observer had also seen it going round like a Catherine wheel, but nobody has ever seen this startling spectacle since, and unfortunately we are not likely to see it next June.

The Mysterious Sunspots

In recent years a connection has been looked for between the long streamers of the corona and sunspots, which are also somewhat mysterious and have been so ever since their discovery in 1610 by the Jesuit, Father Scheiner. They look like black holes in the surface of the Sun, and Sir William Herschel was so impressed by this appearance that he came to the conclusion that the Sun was quite possibly cool and habitable below the fiery envelope that is hot enough to turn metals into vapour—a view that, needless to say, is not held to-day!

By observations over many years it has been discovered that the size and number of sunspots slowly increase and decrease in cycles of about 11 years. For instance, the year 1883 was distinguished by great spot activity which diminished until 1889, and then increased until in 1894 sunspots were again large and numerous.

The variations in sunspot activity are of great importance to us on the Earth, for it is by no means impossible that a clear connection will be traced eventually between these variations and changes in our weather and temperature. It has been found also that the spots are magnetic, those on opposite sides of the Sun's equator having opposite magnetic polarities. This too, is of importance to us, for it is found that immense magnetic storms, which may last for several days and cause great trouble and delay in telegraphic work, are likely to occur on the Earth when sunspots are active. Readers interested in radio will no doubt have read accounts of such effects, as they are perhaps even more noticeable in wireless than in ordinary telegraphy. This disturbance, in fact, is due to nothing more or less than a kind of wireless wave transmission from the Sun to the Earth, and it is at these times also that the mysterious Northern Lights are best seen.



This splendid photograph, which shows a remarkably large prominence, was taken during the eclipse of the 29th May 1919, at Sobral by Dr. A. C. D. Crommelin, of the Greenwich Expedition sent out to Brazil to observe the eclipse

As already suggested, there seems to be a connection between sunspots and the corona. When the spots are active, the coronal streamers are spread out all round the disc and are not very long, and it is at the times in between when the long wing-like structures are seen at their best. Unfortunately, 1927 is a year of great activity, so that a striking corona like that of 1878, illustrated in last month's article, is not to be expected.

Enormous Flames on the Sun's Surface

One result of the discovery of Baily's Beads was that close attention was directed to the edge, or limb, as it is called of the Sun during eclipses. That this was of interest had been noted long before by Captain Stannyan, who saw a total eclipse at Berne in 1706. Writing to Flamsteed, the well-known English astronomer, he says: "The Sun's getting out of the eclipse was preceded by a blood-red streak of light from its left limb, which continued not longer than six or seven seconds of time." Flamsteed seems to have thought that this red streak came from the Moon, but by the middle of last century it was recognised that what was seen was actually the outward leap of a huge mass of incandescent gas from the Sun.

These masses of gas are called prominences, and they have been of absorbing interest to astronomers for many years. They may be seen at practically all total eclipses, appearing suddenly at the edge of the dark Moon as vivid blood-red flames flaring out into the gathering darkness. Sometimes they have been so bright as to be visible for several minutes before totality in front of the advancing disc of the Moon, and later behind it for an equal length of time. They are portions of the chromosphere, a rosy luminous ring surrounding the Sun.

The chromosphere with its accompanying prominences can only be seen ordinarily at eclipse times as its light is usually completely blotted out in the brilliant white glare from the Sun's disc. As early as 1868, however, a method was discovered by which the prominences may be seen at any time. This discovery was made simultaneously by two noted astronomers, Sir Norman Lockyer and M. Janssen, the latter of whom had travelled to India to observe the eclipse visible in that year. In this method use is made of the spectroscope, an instrument that analyses light. A narrow line of the light to be examined is first obtained in this instrument by passing it through a slit, and this line is then passed through a glass prism. When treated in this manner the white light of the Sun is spread out into a band containing all the colours of the rainbow in the order red, orange, yellow, green, blue, indigo, violet, the spreading out being due to the fact that rays of blue light bend more in passing from air into glass than yellow rays, the latter more than red, and so on. The band of colour then, or "spectrum" as it is called, is a continuous set of images of the slit in the various colours in the order named.

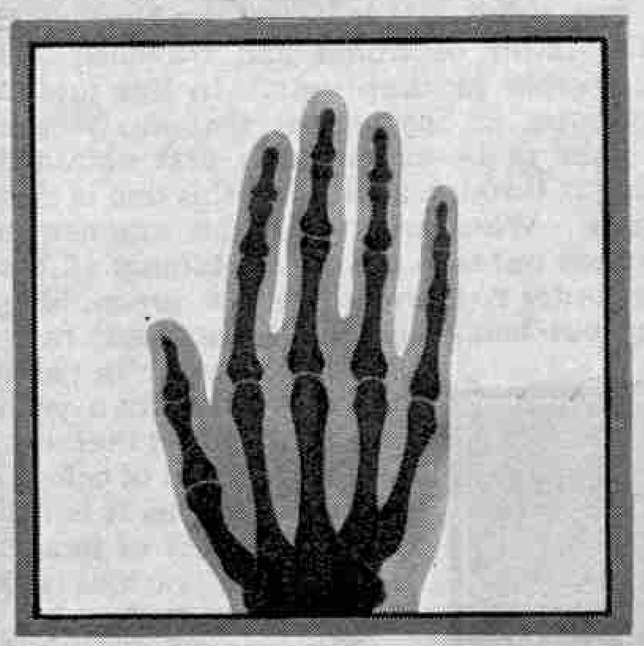
The use of this instrument during totality at the eclipse of 1868 had shown that the light from the prominences was comparatively simple and was not therefore spread out over the whole spectrum by the prisms in the same way as the complex white light. It occurred to the two astronomers named that by passing the light from the edge of the Sun through a large number of prisms to spread it out into a spectrum there was a possibility that the intensity of the ordinary sunlight would be so much reduced by being spread out in this way that the simple light from the prominences would be visible. On the day after the eclipse, M. Janssen directed his telescope to the Sun's limb and passed the light from it through the prisms in the spectroscope. To his delight the difference of illumination was sufficient to reveal the light of the prominences clearly. By using a mirror to project an image of the edge of the Sun on the slit of the spectroscope and opening this fully, it was then found possible to see the prominence printed in one colour, so to speak. Further extensions of the method now enable astronomers to photograph prominences all round the Sun with one exposure in full daylight, while at total eclipses they are only directly visible on the edges of the Sun.

A feature of special interest in connection with the eclipse that we shall see next June is that the disc of the Moon will appear to be only slightly larger than that of the Sun—as was mentioned in last month's article in explaining the narrowness of the track—and it may be possible, therefore, for the first time in history to see prominences all round the Sun instead of on one side only at a time. Should this be the case, the Sun will appear to be surrounded by a crimson ring, with the corona encircling this, and the shortness of the duration of the eclipse will thus be compensated by the extra brilliance of a spectacle that has never been seen before.

The Great Prominence of 1919

If by good fortune a prominence of the size of that shown in the photograph on this page is visible, then the coming eclipse will be very remarkable indeed. This prominence was photographed by Dr. A. C. D. Crommelin, who went out with an official party from Greenwich Observatory to Sobral, in Brazil, to observe the eclipse of 1919. The material of the prominence was thrown out from the funnel-shaped portion at the lower end, and formed a cloud-like mass that curved back to the Sun once more over 300,000 miles away, while portions fell in curved wisps within the main curve. At the same time this prominence was being photographed at the famous Yerkes Observatory in Chicago by the method referred to above, and as the observers there were not dependent on an eclipse they were able to obtain photographs of the rapid changes that it underwent. They found that the central cloud-like portion separated from the rest and parts of it floated away to a height of nearly half a million miles before finally disappearing.

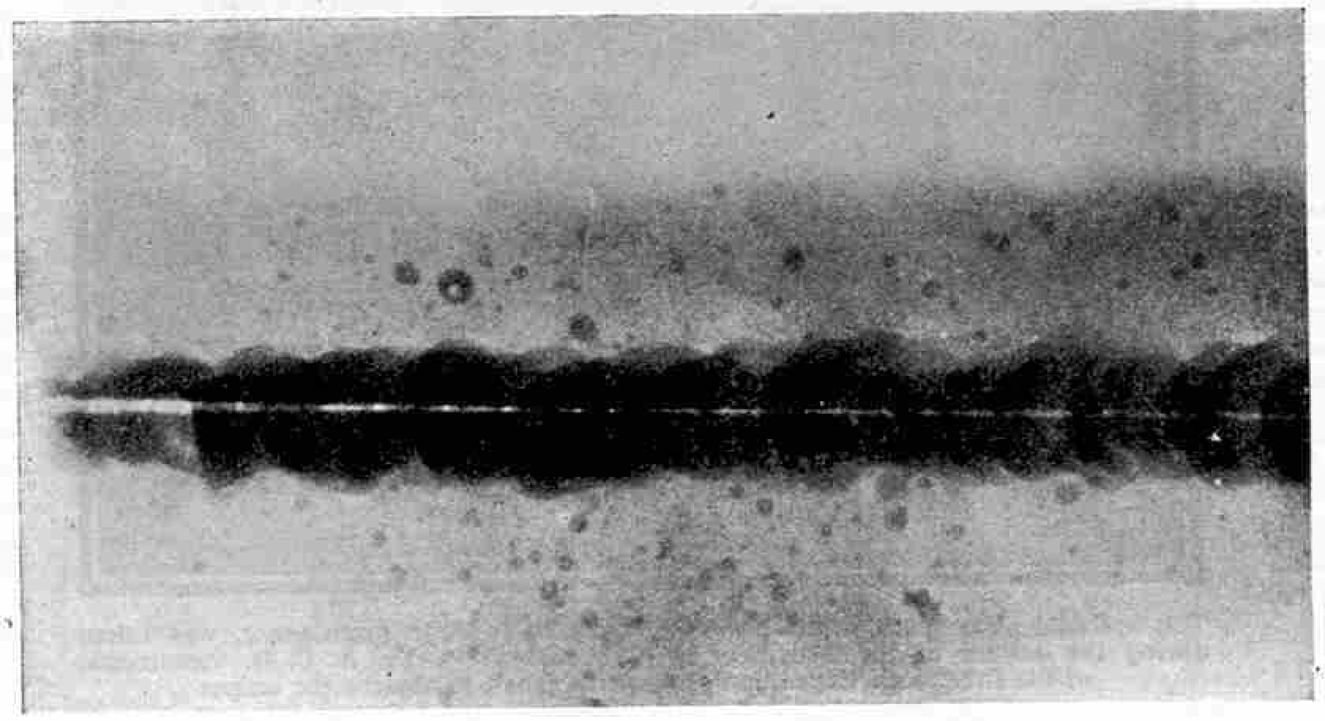
Some idea of the immense size of this (*Continued on page* **346**)



Electricity

XXXV. X-RAYS—THE "WATCH-DOGS OF INDUSTRY"

LAST month some of the applications of X-rays to the detection of faults in metalwork were explained, and in continuation we now have to consider the examination of joints. The safety of human life depends too often upon the soundness of welded or riveted joints to allow the neglect of any means of testing them, and the only method by which their soundness can be demonstrated, apart from tests to destruction, is by X-ray examination, which instantly reveals any gaps or bad joinings. An example of bad workmanship of this kind is shown in Fig. 1, which shows an oxy-acetylene weld in a steel plate. This was apparently a perfect weld, but, as the illustration shows, the joint has not been made in a satisfactory manner at all.

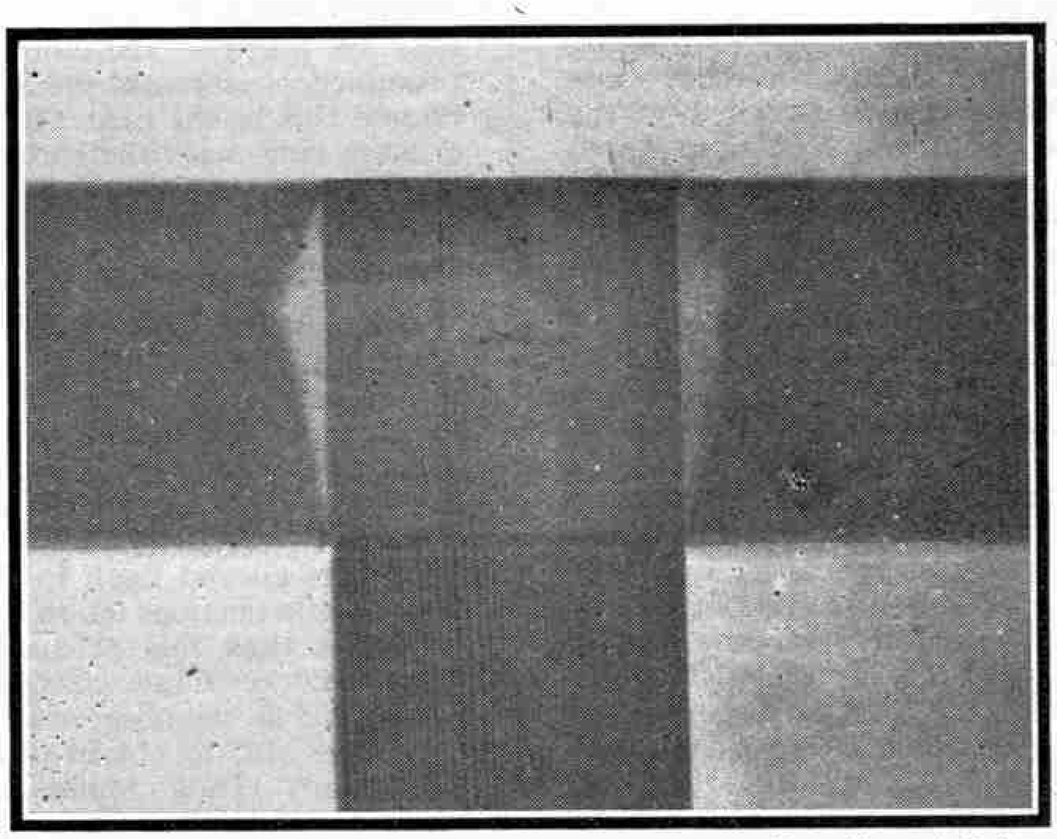


Courtesy [*Loughborough College*

Fig. 1. Oxy-acetylene weld in steel plate, showing serious gaps in the joint

Tests to Wireless Apparatus

Methods similar to those used for metals can be applied also to a wide range of other materials, and there are many applications of X-rays to industry in which what are termed "softer" rays may be employed advantageously for the examination of raw materials and finished products. For instance, the value of ebonite for insulating purposes in wireless and other electrical apparatus is obviously reduced by the presence of impurities. These have an absorptive power different from that of ebonite, and a photographic test with X-rays will show their presence.



Courtesy [*Loughborough College*

Fig. 2. Bad workmanship revealed by X-rays—a faulty mortice joint

One application of interest is to the testing of golf balls. These contain a heavy rubber core upon which rubber strips are wound. If the core is not a true sphere the ball does not fly straight and much bad golf—and bad language—is the result! This possibility can be avoided by looking at the core of the ball itself when manufactured. Fig. 3 is a radiograph of new golf balls, and it shows that the rubber core is often by no means either round or central.

In many other branches of industry various tests and examinations are necessary. The purchaser wants to know that the raw material he buys is up to specification, and the manufacturer is anxious to see that the workman is putting good craftsmanship into the job. For example, a boot manufacturer purchases leather and turns out boots. X-ray examination of the leather may tell him much that a superficial examination will not show, while the X-ray examination of the finished boot will unerringly reveal defects, such as unclenched sprigs, filling, or faking of almost every kind. Of course, it would be a big undertaking for a manufacturer to X-ray every pair of boots turned out of his factory, but it is easy to see that the possibility of a more stringent examination of at least some of them must tend to raise the standard of workmanship.

Cricket balls, rubber tyres, wood spokes for wheels, and many other articles are

now tested by means of X-rays. Imitation diamonds can be distinguished from real ones by the dense shadow of the lead in the glass of which they are made. One of the earlier uses made of the rays was to detect pearls in oysters without opening them, and the new "cultivated" pearls, when subject to the rays, readily show the nucleus around which they are grown.

Still other examples in connection with many classes of industry could be given, such as the examination of cigars, electrical insulators and, in the case of foodstuffs, the detection of impurities, the separation of stale and fresh eggs and the examination of cheese.

It has been pointed out already that the safety of human life is often dependent on the soundness of the materials used in the construction of buildings or machinery, and that X-rays provide the only method of testing finished products. An important example of this is in testing the soundness of blocks of ferro-concrete. In reinforced concrete work, the iron bars, cement, etc., employed may be tested separately, but once the block of ferro-concrete has been made and put into position, information as to its soundness can be obtained only by the use of X-rays. These make it possible to see if the iron bars have rusted or warped, if the concrete has developed cracks, or if anything else has occurred to reduce the strength of the block. This is particularly important in the case of ferro-concrete used for marine purposes, for splits in the concrete are often caused by the rusting of the enclosed steel, as this results in expansion. The only way in which this internal action can be studied is by means of X-rays and, by their aid, ways and means will probably be developed of increasing the margin of safety in the erection of modern ferro-concrete structures.

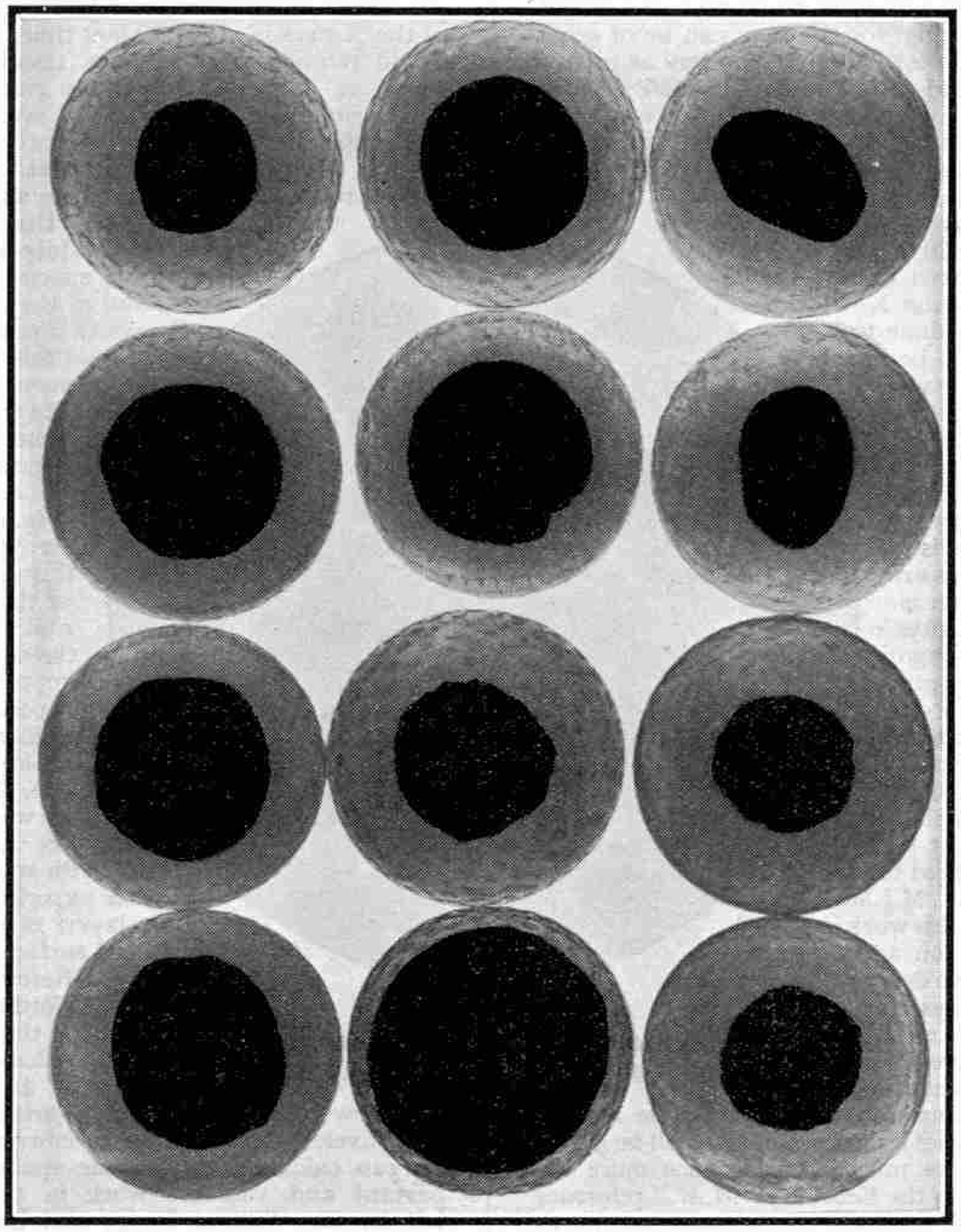


Photo courtesy] [*Loughborough College*

Fig. 3. Unused Golf Balls of Various Makes

Safety in Aeroplanes

An even more important example is the testing of aeroplane work. Here the slightest flaw in any portion of the material used, or in the workmanship with which the parts have been assembled, may result in a fatal mishap, and consequently rigid tests are very necessary. The metal and timber used in an aeroplane are thoroughly tested at all stages of manufacture. Hidden knots, bad grain, grub holes, and pockets filled with the resin are the chief defects to be looked for in timber, and they are easily detected by X-rays.

Here again it is in the examination of the finished products that the greatest usefulness of the X-rays is found, and the workmanship is subjected to a merciless scrutiny. The all-seeing rays instantly detect any dodging or bad work such as badly-fitted joints, irregular gluing of parts, and the splitting of wood by screws, and no attempt to cover up bad work by means of glue and shavings has the slightest chance of success. For work of this kind portable X-ray outfits are now made, of such a shape and size that they can be manœuvred about a finished aeroplane. They are arranged so that they can be used either for a rapid inspection with the aid of a fluorescent screen or for securing a permanent record by photography. An example of the use of X-rays to detect faulty workmanship of this kind is shown in Fig. 2, which shows a wood joint in which the mortice has been badly cut.

An interesting side line is the examination of antique furniture, pictures, etc., in which faking may generally be detected. If two photographs are taken using localising apparatus, the radiographs may be examined by means of a stereoscope, when the internal structure appears in relief. A simple but interesting example of this can be arranged by obtaining X-ray photographs of samples of coal. A single photograph shows the layers of mineral matter as patches or streaks, whereas a stereoscopic photograph shows the foreign matter in relief, and the general structure of the coal can be appreciated very much better. Similar remarks apply to the metallic veins in minerals, and it will be realised that there are considerable opportunities for research in this direction.

An X-ray photograph of coal does not give a clear indication as to the amount of foreign matter present. If the coal is powdered, however, and shaken up in an aluminium container, the mineral matter tends to sink to the bottom, and the amount of "sediment" is easily revealed in an X-ray photograph. This gives a very simple and rapid method of comparing samples of coal.

Another method that has been suggested for the examination of nuts or beans of anthracite for gas producer plants is to arrange a tray having, say, 50 divisions. If a piece of coal be placed in each division, the percentage of the pieces containing mineral matter may be quickly determined.

In the foregoing examples, the examination may be made simple by means of the fluorescent screen, and where a large number of parts require to be examined, simple appliances such as a belt conveyor may be arranged to reduce the time taken.

Future Uses of X-Rays

The use of portable plant of the kind already referred to is some indication of future uses of the rays, when it will be part of routine work in engineering shops, for instance, to pass all finished work through an X-ray testing room equipped to carry out the necessary examinations rapidly and almost automatically, just as similar operations are carried out to-day in a well-organised hospital. Another industry in which the possibilities of X-rays are as yet practically unexplored is coal mining, for the rays can be of great assistance in the study of the composition of coal as well as for the detection of defects in the fuses and detonators used for shot-firing.

It is putting the case mildly to say that the application of X-rays to industry is absolutely in its infancy, and the development of improved methods of producing the more penetrating X-rays undoubtedly will lead to great extensions.

The Research Department of Woolwich Arsenal predict that a penetration of 12 in. or even 20 in. may be attained in the future. As already pointed out, the chief obstacle in the way of progress is the X-ray tube itself. Although much has been done to solve the problem, much still remains to be accomplished, but with more powerful tubes, or with a better method of producing the rays, the penetration predicted will doubtless be attained.

Though several of the more progressive firms have now installed X-ray apparatus in their test rooms, there is no doubt that much wider applications are possible. Greater interest than ever is being taken in the application of X-rays to industry. About five years ago, for instance, a powerful experimental plant was installed at Loughborough College, and research has been, and still is being carried on with a view to exploring the possibilities of such applications. Many of the X-ray photographs illustrating this article have been taken at Loughborough, and we are greatly indebted to Mr. J. F. Driver, D.L.C. (Hons.), M.I.E.E., M.I.Mech.E., Head of the Department in which this work is carried out, for much valuable information and assistance.

In this series of articles we have dealt so far with the discovery and production of X-rays, and also with their use in surgery and industry. Of late years they have been applied to the solution of scientific problems of a somewhat surprising and very remarkable nature, and before leaving the subject a brief indication of this will be given. To follow this new application we must consider once more the nature of the rays. On page 113 in the February "*M.M.*" reference was made to the fact that the X-rays are of the same nature as light, but that there were formerly differences of opinion owing to certain difficulties that showed themselves.

No Surfaces Smooth to Rays

One of these differences was in regard to the reflection of X-rays. If ordinary light falls upon a surface that is very rough and lumpy no reflection of the ordinary kind will be obtained at all, but if the surface is polished until it appears to us to be smooth, then we shall get reflection as in mirrors. When the early experimenters attempted to reflect X-rays, however, their efforts resulted in failure. We know now that the trouble was that their wavelength was about 10,000 times smaller than that of ordinary light, so that a surface that was just of the right degree of smoothness to ordinary light would still be extremely rough to X-rays.

A similar state of affairs exists when we consider the passage of light through glass prisms. Ordinary light is bent in passing through them, but the effect cannot be traced with the X-rays, again on account of their very small wavelength. The same bending takes place when light is passed through what is known as a diffraction grating. Gratings are usually made nowadays by scratching a number of very fine parallel lines on a glass surface, or by photographing one already made, also on the glass. This is usually done by means of a remarkable ruling machine constructed by H. A. Rowlands, a famous American scientist who devoted years of work to the making of a perfect screw to enable him to construct a machine capable of ruling thousands of lines per inch with great accuracy.

Suppose a narrow slit of light is projected at right angles on to such a grating and viewed from the other side. In the centre a narrow slit of white light that has come straight through is seen, and on either side are colour bands at regular intervals depending on the spacing of the lines on the grating. In testing X-rays in the same manner it is necessary, of course, to substitute a photographic plate for the eye, and when this is done no effect of this kind is obtained with ordinary gratings.

X-Rays and Crystal Structure

The reason for this, as already suggested in the February "*M.M.*" is that the wavelength of the X-rays is far too small for the gratings in use. For ordinary light a grating with about 17,000 lines per inch gives very satisfactory results. As the wavelength of the X-rays is about 10,000 times smaller, the gratings necessary would require to have lines about 10,000 times nearer to each other, or in other words the gratings should have 170,000,000 lines per inch! No machine ever constructed could possibly rule such a grating. No wonder then that X-rays at first appeared to defy the ordinary laws of light!

Eventually, however, the happy suggestion was made by a German scientist named Laue that the regularly spaced avenues of atoms in crystals should behave as a diffraction grating, the spaces of which should be exceedingly small and of the right size to show the effect with X-rays that ordinary gratings show with light. On trial this proved to be the case. It must be remembered that this regular arrangement of the atoms in a crystal is in space, and therefore in three directions, while the gratings used for ordinary light have lines in one direction only.

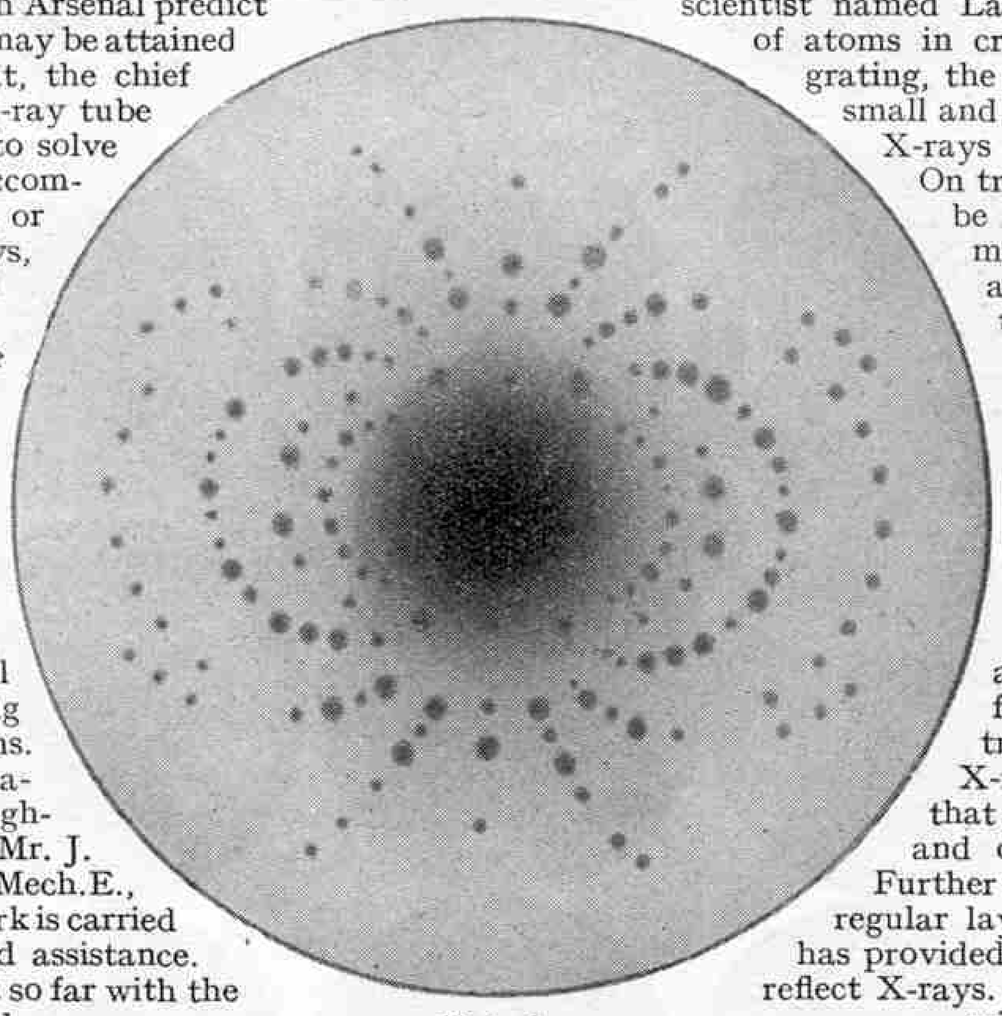


Fig. 4

The symmetrical pattern obtained on a photographic plate by passing a beam of X-rays through a thin crystal

Fig. 4 shows what happens when a narrow beam of X-rays is passed through a crystal. The greater part of the beam passes straight through and produces the black mark in the centre of the figure, but a certain proportion is bent or refracted by its passage through the crystal, and a regular pattern is produced, as shown for a crystal of anhydrite in our illustration. This discovery of the bending of X-rays was the complete and final proof that there was no difference between X-rays and ordinary light, except in wavelength. Further experimental work showed that in the regular layers of atoms forming crystals, nature has provided surfaces sufficiently perfect to actually reflect X-rays. Referring again to the gratings used with ordinary light it is possible, if we know the distance the lines are apart, to calculate the wavelength of the light. In a very similar manner, if we know the atomic spacings within a crystal, we can calculate the wavelength of X-rays, or conversely, knowing the wavelength, we can calculate the atomic spacings of the crystal. Most important and valuable work in this direction has been carried out by Sir William Bragg and his son Professor W. L. Bragg, who were awarded the Nobel prize in 1915. As the crystal helped to explain the nature of X-rays, so in turn the X-rays help enormously in explaining the nature and structure of crystals. In fact we may say that the X-rays have enabled us to see in an indirect manner the tiny atoms of which substances are composed.

The metal iron gives us a simple example of this use of X-rays. It is well known that substances usually expand when heated. If, however, an iron wire is heated, say by passing an electric current through it, it lengthens steadily as it grows hotter until the temperature reaches about 900°C., when it momentarily stops expanding, and even contracts slightly. Then it again expands as the temperature increases further.

An X-ray examination of iron at various temperatures has shown that the atoms in the crystals of iron are packed together more tightly above the critical temperature than below. It is obvious, therefore, that the curious behaviour of the wire is simply due to the rearrangement of the atoms, which pack themselves more closely together when that temperature is reached.

It is perhaps surprising to learn that metals are built up of crystals in exactly the same way as are such substances as sugar or common salt. This is the case, however, and the toughness, hardness, ductility, and other properties of a metal are closely connected with its crystalline structure. The physical properties of steel, for instance, depend very largely on the nature and size of the crystals of the iron and carbon present. It is reasonable to predict, therefore, that the investigations on crystals conducted by the aid of X-rays will at no distant date lead to far-reaching practical results.

A Visit to a Machine Shop

Interesting Work Done at Parkhead Forge

A VISIT to a large Machine Shop is always an interesting experience and recently the writer had an opportunity of going over the large Machine Shops at Parkhead Forge, owned by William Beardmore & Co. Ltd. Here, even following the years of industrial depression, culminating in the stagnation produced by the Coal Strike, there is always something of peculiar interest to be seen.

Amongst work that has gone through recently were cast steel yokes for generators of considerable size. In cases where the armature revolves at a slow rate, and in order to obtain the necessary high peripheral speed, the diameter has to be of considerable size. In the particular yokes under consideration the inside diameter was 17 ft. and the outside 22 ft., with a width of 3 ft. The weight of each complete yoke was 11 tons 8 cwt.

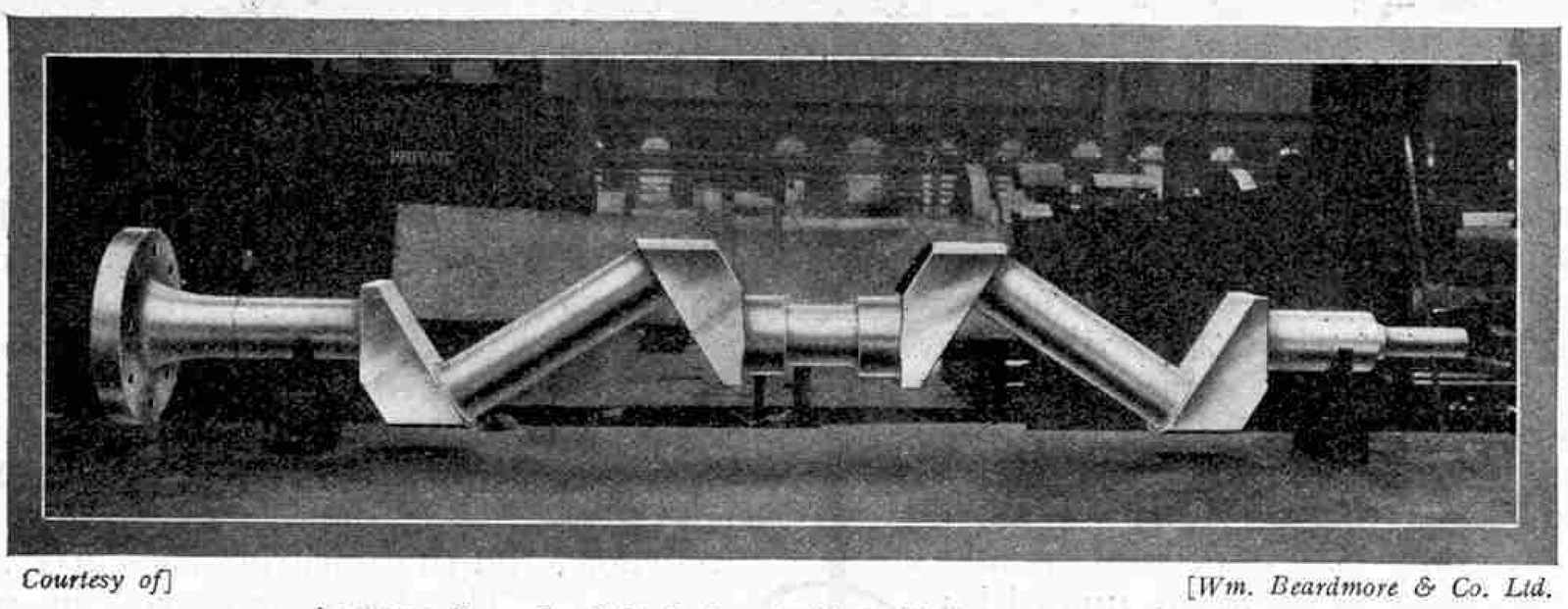
Yokes considerably larger than this can be undertaken at Parkhead, and it is interesting to know that one enquiry the firm recently received was for a yoke of no less than 40 ft. in diameter.

Rims for Turbine Gear Wheels

A similar class of job is turbine gear wheel rims. The process of manufacture of these gigantic gear wheels, which are employed for reducing the rate of revolutions of ships' turbines from some 3,300 revs. per min. to 90 revolutions of the propeller, is amongst the most interesting in engineering. The process was fully described in an illustrated article in our issue for November 1925.

An ingot is first cast of some 5 ft. in diameter by between 10 and 15 ft. in length and weighing roughly 60 tons. The ingot is heated, and forged into a bloom cylindrical in form. The bloom is annealed in a special furnace, and when cold is trepanned and parted into three or four pieces. These pieces are then expanded under the forging press into rings of the required diameter from 5 to 14 ft. The hollow forged rings are next annealed and sent to the machine shops, where they are next bored and turned in a large 14 ft. turning and boring mill of a very heavy type. This being the function of the Forge Machine Shops, they are then despatched to the shipyard, where they are shrunk on to the wheel centres and the teeth are cut.

Such work requires a special class of machinery, and the tools used are similar to those employed in the making of giant flywheels.



Courtesy of] [*Wm. Beardmore & Co. Ltd.*

An extraordinary Crank Shaft, forged with the Shafts set at an angle of 30°

Extremes in Gears

Another interesting operation seen at Parkhead was that of gear cutting. The plant installed is capable of dealing with plain spur gears up to 8 ft. in diameter, with spiral gears and worm wheels up to 3 ft. and bevel gears to 2 ft. diameter. At the same time the shops can turn out gear wheels down to the smallest sizes.

One order recently executed was for valve timing gear for a motor cycle engine, and the largest pinion in the set measured but ten millimetres in diameter. It is a far cry from such products to the latest gear wheel turned out by the Machine Shops which is of 8 ft. diameter, 2 ft. wide, with teeth of $3\frac{1}{4}$ inches pitch, and a weight of 2 tons 16 cwt.

One of the most recent jobs delivered from the Forge Machine Shops was a winding engine drum shaft for gold mines abroad. Being in four pieces bolted together, this had to be made to extremely small limits, and from end to end the truth was within two thousandths of an inch.

The total length was 60 ft. 9 in., carried on five bearings, three of 25 in. diameter and two of 18 in. The couplings measured 3 ft. 10 in. diameter, and the shaft at its largest diameter was 2 ft. $10\frac{1}{2}$ in. It was hollow throughout, the hole being trepanned in a special machine. A very much larger drum shaft is at present in hand requiring a 115-ton ingot to make one of the pieces.

Value of Trepanning

It may be mentioned that the Machine Shops at Parkhead are particularly well equipped for trepanning small holes in rotor and other similar forgings.

Trepanning, which means cutting a solid piece out of the metal instead of boring it out in a lathe, is of great value, in that it enables a close examination of the condition of the internal part of the shaft to be made from the core.

In the case of very small holes, trepanning is difficult, if not impossible, and in these cases the holes are bored out of the solid in the usual way.

The weight of the drum-shaft referred to totalled 51 tons 10 cwt.

A Weird Crankshaft

The finest piece of work turned out by the Machine Shops during the past few months,

(*Continued on page 359*)

THE STORY OF COAL

III.—BORING OPERATIONS AND SHAFT SINKING

IN the concluding paragraph of our article in this series last month we referred to the operation of boring for coal carried out by the prospector. This task represents the first practical step towards establishing a coal mine, and while the work is slow and monotonous it is of the very greatest importance.

When the location of a new coalfield has been geologically defined, boring is commenced in order to discover how far the estimate of the geologists is correct, and further, to ascertain the important point as to whether the coal exists in sufficient quantities to be profitably worked.

The boring operations are carried out either by a percussive or a rotary system. In the former a steel chisel is fixed to the lower end of an iron rod 18 ft. in length and about $1\frac{1}{4}$ in. square. This rod is driven steadily downward and the chisel bites into the earth, penetrating rapidly in soft soil but slowing down considerably when rocky strata are reached. A slight twist is given to the rod before lifting it from the cavity after each blow and a circular hole is thus gradually cut out of the rock. As the bore deepens, additional 18 ft. lengths of rod are screwed on.

The borehole soon begins to choke up with the loosened debris, and the cutter is then temporarily laid aside and a "sludger" lowered down the narrow cavity. The sludger, so named from the mud or "sludge" it collects, is a long tube with a valve at the base that works like the valve of an ordinary lifting pump. When brought to the surface the sludge is examined for information as to the nature of the ground being bored through. An experienced borer can detect merely by the changed vibrations of the rods when the chisel has cut into some new or different stratum.

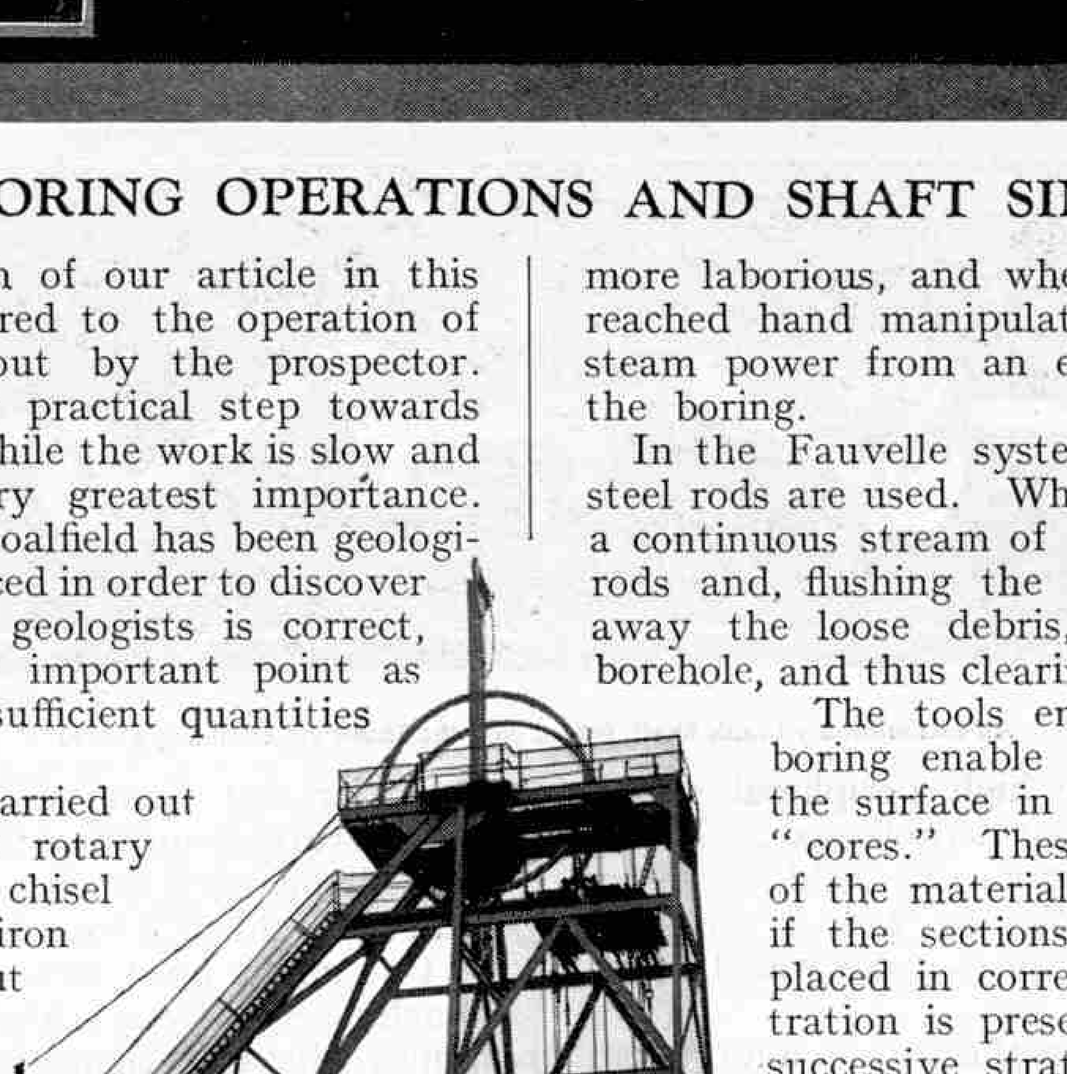
The increasing length of the rodding as the boring deepens renders the task of operating the tool more and more laborious, and when a depth of about 250 ft. is reached hand manipulation has to be superseded by steam power from an engine erected at the head of the boring.

In the Fauvelle system of percussive boring hollow steel rods are used. While the cutter is being operated a continuous stream of water passes down inside the rods and, flushing the bottom of the boring, carries away the loose debris, washing it up out of the borehole, and thus clearing the cutter.

The tools employed in rotary systems of boring enable the debris to be brought to the surface in cylindrical sections known as "cores." These not only disclose the nature of the material penetrated by the cutter, but if the sections are carefully preserved and placed in correct sequence an accurate illustration is presented of the thickness of each successive stratum. The various coal seams bored through will be represented by so many black sections of core interspersed with sections of rocky or other matter.

In the rotary system of boring invented about 50 years ago by Captain Beaumont, a wrought iron crown is fitted to the bottom end of the hollow rodding. Inferior diamonds set in the bottom rim of this crown grind away a ring of rock as the tool is rotated at about 300 revolutions per minute, leaving a rocky pillar—the core—which is accommodated in the hollow of the rods. Periodically the core is automatically broken off, brought up with the tool and removed for examination. While boring is in progress water is fed down the hollow of the rods, escaping through vertical apertures, and is drawn up to the surface again by an auxiliary pump. This type of rotary boring tool has been used very successfully in operations carried to depths of more than 2,000 ft.

The cutter used in the Davis-Calyx system of rotary boring employs, in place of diamonds, a steel ring



A general view of the Newdgate Colliery showing miners returning to work on the re-opening of the pits after the strike last year

having its lower edge notched after the manner of a saw. This appliance has been employed for boring operations in the new Kent coalfield, where one particular boring revealed coal at a depth of 1,437 ft. As many as 13 seams of the mineral were penetrated before operations were discontinued at a depth of 2,276 ft. Rock strata ranging from a few feet to 223 ft. in thickness lay between the various coal seams, which were from 1½ ft. to fully 6 ft. thick.

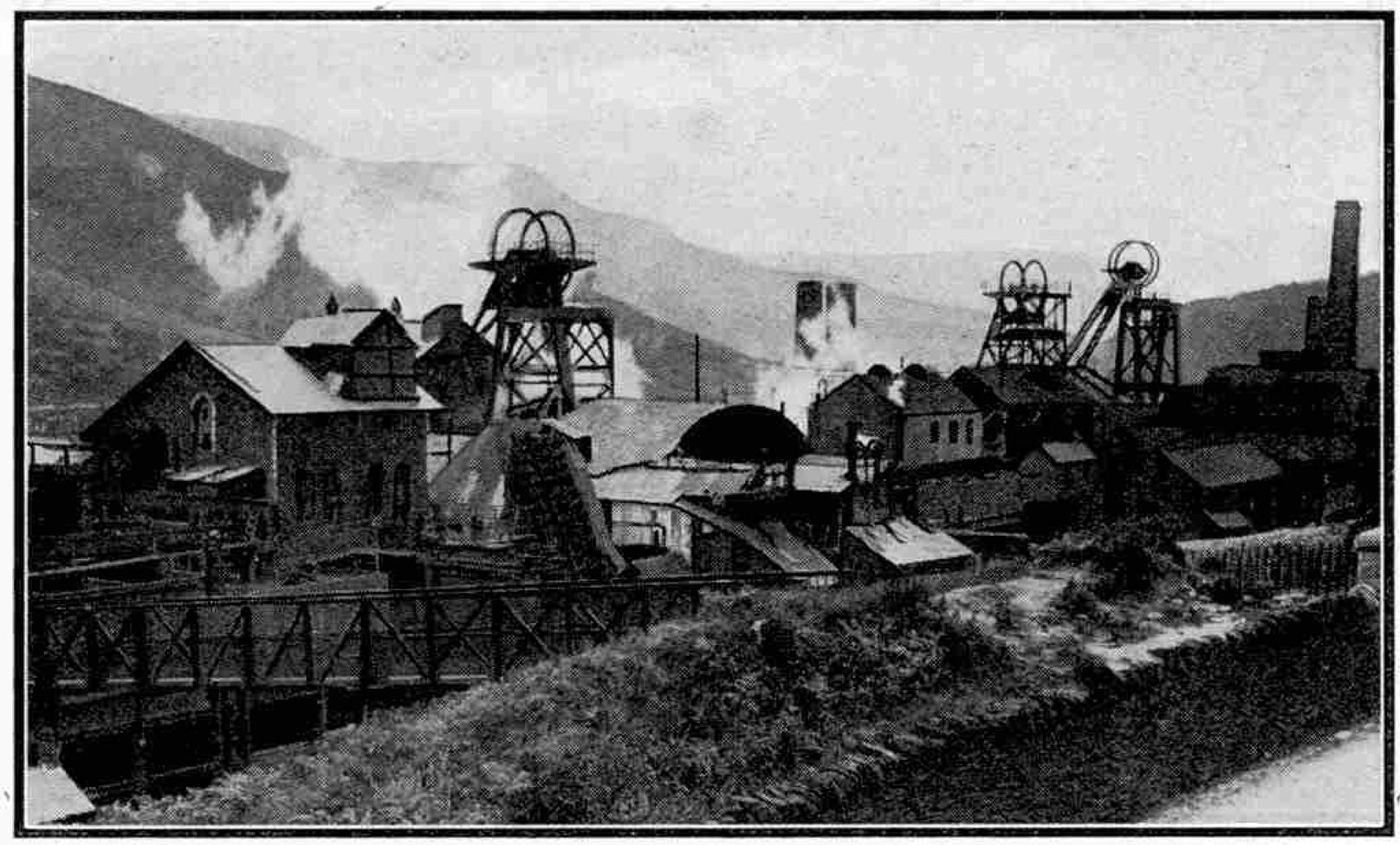
A little over a year ago borings made in North Oxfordshire disclosed a rich coal seam only 700 ft. below the surface, while a boring made at Doddington, on the western border of Lincolnshire, did not penetrate the first coal seam until a depth of 2,703 ft. had been reached. Cutting was continued at the latter locality for a further 900 ft., in the course of which 11 coal seams were passed through. As a general rule, however, only seams of 2 ft. or more in thickness are regarded as profitable to work, and of the 11 disclosed by the boring at Doddington three are stated to be workable.

A single boring does not "prove" a coalfield, and boring operations are carried out over a wide area until the engineers have learnt the extent of the coal-bearing area, the number and average thickness of the coal seams and the general quality of the mineral. If the results of the borings are satisfactory the engineers then turn their attention to deciding where the pit shafts shall be sunk. This is a momentous question, and every care is taken in choosing the sites.

Although borings yield much valuable information they are never regarded as infallible, for a boring may miss by only a few inches some underground stream or hidden quicksand that will only be discovered when the small borehole gives place to the wide cavity of a shaft. Huge sums of money have been spent in battling with these dreaded obstacles to successful shaft sinking, and sometimes in the end the engineers have had to abandon their efforts. Those responsible for deciding the location of the shafts have also to make sure that ample room in the immediate neighbourhood is available for the railway sidings, waste dumps, coke ovens and washing and screening plants that later will be necessary. It is thus no simple matter to decide exactly where shaft sinking shall be carried out.

Sinking the Shafts

In determining what form of vertical shaft shall be sunk for a new coal mine many factors have to be considered, two of which are the nature of the strata separating the various coal layers and the kind of lining the shaft is to have. England and many European countries favour the circular shaft, which is admirable for resisting the tremendous pressure exerted by soft strata, and is lined with iron sheeting or brickwork. Oval-shaped vertical shafts, of which a number exist in the South Wales coalfields, are also lined after the manner of circular shafts. America has adopted mostly a rectangular type of shaft and in some instances reinforced concrete has been used for the lining in preference to the timber lining common to the type. Rectangular shafts are very suitable and cheap to construct where borings have shown the strata between the coal seams to be hard and solid.



A typical South Wales coal mine at Pontypridd

When all matters of detail are duly settled, the work of excavation is commenced, winding gear being erected over the site for hauling up the debris. When the surface layer of soil has been penetrated and rock is reached, digging by hand gives place to a powerful boring machine. This modern device consists of a number of mechanical arms radiating from a central shaft and each terminating in a securely held power drill for making holes to receive a charge of explosive. After it has done its work the machine is removed and blasting carried out.

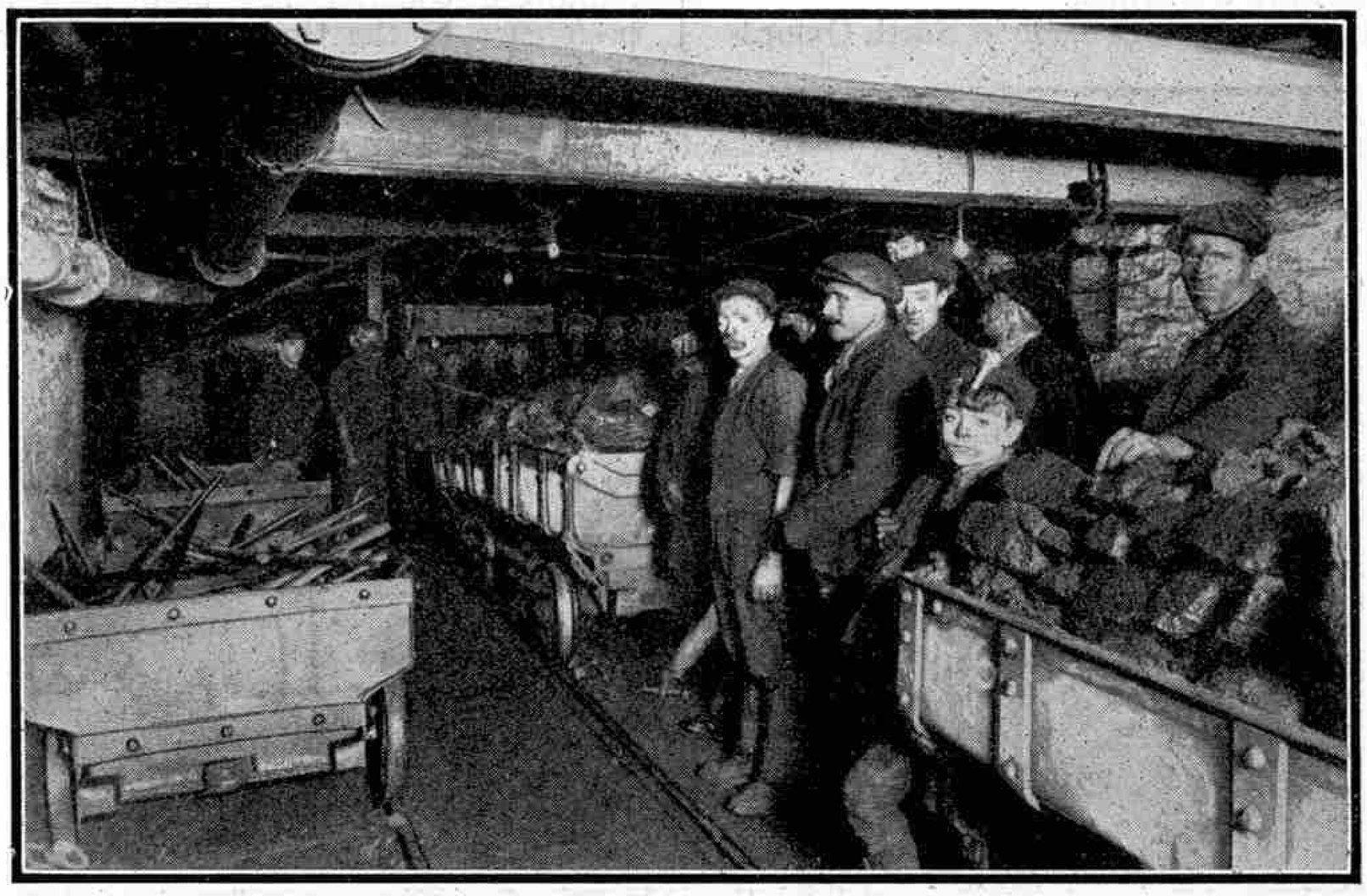
As the aperture for the shaft deepens to the first layer of rock, the sides are supported by a temporary lining of flat steel rings fixed with strong metal hooks, and backed by a wall of planking secured with wedges. The rings are placed about 3 ft. apart. When at length solid rock is reached the work of providing the shaft with a permanent lining is begun. A cast-iron "bricking" ring is built up from segments carefully lowered down the shaft and is laid in cement or oakum. Upon this metal foundation a brick lining about 1 ft. in thickness is then built up. When the lining is complete, sinking operations are resumed and at a specified depth a second bricking ring is set and the shaft wall built up to the ring above. Thus alternate sinking and bricking continues until the shaft has been carried as far down as required.

The Menace of Water

Shaft sinking is very rarely accomplished without trouble being experienced from influx of water into the excavation. Frequently the water can be baled out by utilising the big iron buckets called "hoppets" used for hoisting up the debris, but if the flooding assumes formidable proportions powerful electric pumps are brought into use. These are carefully suspended in the shaft by wire ropes controlled from a capstan engine situated at the head of the shaft, and can thus be

lowered further as sinking operations continue to greater depth. The pumps are capable of dealing with many thousands of gallons of water per hour against a substantial head, and the water so lifted is pumped to the ground surface through a flexible metallic hose.

The presence of water necessitates not only continual pumping but also the adoption of other methods and materials for lining the shaft. In the system known as "tubbing," for instance, an iron lining is built up instead of a brick one. Flanged, curved, cast-iron plates are erected on the foundation ring and bolted together, forming a complete circle. Successive rows of similar plates are then built up, the various joints occurring as in brickwork and all being interleaved with thin lead sheeting. The plates in each row have a central hole in the front through which water percolating from the earth is allowed to escape until all the plates are secured in position. The deep cavity between the tubbing and the earth wall of the shaft is then tightly filled with concrete which, when solidified forms an impenetrable wall, effectually shutting out the water.



In a typical coal mine—miners and filled trucks of coal waiting to come to the surface at Bargoed, near Cardiff

It is interesting to note that the "tubbing" method of shaft sinking was introduced into the Leicester coalfield by George Stephenson, who opened a colliery at Snibston in 1831. From this colliery Stephenson sent the first trainload of coal to Leicester.

The "King-Chaudon" method is even more drastic and includes the use of huge boring tools, each of which consists of a wrought iron frame wherein a number of steel chisels are set. The tools are known as "trepans," and during operation are suspended by wooden rods from a beam at the shaft head. A hole 5 ft. to 6 ft. in diameter is cut by the first trepan—the weight of which approximates six tons—and is enlarged by a second tool of greater radius. The latter appliance may in turn be superseded by a third and still larger trepan, according to the diameter of shaft required. Mechanical excavators remove the debris speedily created by these formidable cutting tools.

The shaft is lined with metallic rings each of which is cast in one piece and is roughly 4 ft. in height. When all is prepared, these "ready-to-fit" cast iron rings, already secured together to form a huge cylinder, are slowly lowered into the shaft. Beneath the bottom casting is a quantity of moss within a sliding ring. As the cylindrical lining comes to rest, its whole weight is imposed upon the moss and a perfectly watertight joint formed. Space intervening between the tubbing and the earth wall of the shaft is filled with concrete, and when the latter has set, water that has accumulated in the shaft is pumped out, after which sinking operations can be continued.

Fighting Quicksand

Quicksand is another serious menace to the mining engineer, but different defensive methods have to be adopted. Of these, perhaps the best known is the "Poetsch" freezing system invented in 1883. A series of very deep holes forming a wide circle round the shaft area is bored and into each a vertical pipe, sealed at the base, is lowered. Within each pipe is a narrow central tube extending almost to the bottom and when all pipes have been inserted and connected up to the freezing plant, brine, at the low temperature of 5°F., is pumped from the plant and forced down these central tubes. The brine issues at the foot of each tube and rising up between the outer wall of the tube and the inner wall of the pipe, returns to the freezing plant, where it is rid of heat collected on the journey, after which it is again forced along and down the central tubes for further duty. By this continuous extraction of heat the earth around the holes eventually becomes completely frozen. The hardened ground then forms an effective barrier to water and adjacent quicksand alike, and shaft sinking operations can be carried out.

Nowadays two shafts not less than fifteen yards apart are always sunk, one known as the "downcast" shaft being used for conveying men and materials up and down, and the other called the "upcast" shaft being provided for ventilating purposes. The sinking of the two shafts for a new mine is carried out simultaneously and when the required depth has been reached in each case a communication tunnel is constructed. The area at the base of each shaft is widened out into a chamber, although thick columns of coal are left standing to prevent roof falls in the immediate vicinity.

The spacious and carefully constructed shafts of a modern coal mine contrast strangely with the crude workings opened up by the thirteenth century monks, who, finding the supply of coal on the surface becoming used up, had to resort to excavation.

Coal Mining in Early Time

The first coal pits reached to a depth of about 7 ft. and were after the fashion of the "bell pits" from which ironstone was mined at that time, especially in the Leeds and Forest of Dean districts. A coal bell-pit was very soon exhausted, however, for all the miner did was to dig the hole as deep as he desired and then clear out the coal from around him, thus giving the excavation the shape of an inverted basin or a bell. When as much coal had been got away as was felt possible without endangering a fall of roof, a fresh pit was dug close by, the earth removed being used to help to fill up the previous excavation.

As the demand for coal increased it became necessary to work seams of coal lying deeper in the earth. Seams outcropping on a hillside were followed up by narrow tunnels variously named "day holes," "adits" or "levels." These tunnels served the double purpose of providing means of entry and exit to and from the mine and drainage for any water encountered during the operations. On level country sloping shafts were excavated to various depths up to 25 ft. and a small tunnel about 18 in. in diameter was cut from the foot of the shaft to the nearest valley or declivity as an egress for water. Sometimes these drainage tunnels had to be cut for many miles before reaching lower country that provided a natural basin into which the water could run. Narrow sloping galleries were driven off from the main shaft and were supported by leaving the coal unworked here and there in the shape of rough columns. This was called the "Pit-and-Adit" system of which the present day "Pillar-and-Stall" method is a modern version. Manual labour was employed to remove the coal from the mine.

An interesting sidelight upon these early methods is given in an old document published in 1796, but written almost 200 years earlier by a man named George Owen, who says: "In former tyme they used no engins for lifting up of the coles out of the pitt, but made theire entrance slope, soe as the people carried the coles upon theire backs along stayers, which they called landways; whereas now they sink theire pittes down right foure square, about six or seaven foote square, and with a wyndles turned by foure men they draw up the coles, a barrell full at once by a rope; this they call a downright dore."

In time the shafts and galleries were carried to depths lower than the drainage tunnels, thereby rendering it necessary to devise improved means of getting rid of the accumulating water. In the 15th century the first pumps used in coal mines were installed, and by the 17th century vertical shafts were being sunk to a depth of 100 ft. or more. The invention and subsequent development of the steam engine enabled mining operations to be carried

to hitherto unprecedented depths, and about the time that Murdock introduced lighting by coal-gas, pit shafts were being sunk more than 500 ft. deep.

Single Shafts Abandoned

It was as yet a general practice to sink only one shaft for traffic and ventilation purposes alike, and to divide the shaft into two compartments by a wooden partition. As is so often the case, a wrong state of affairs was remedied only after a tragic mishap proved the need of reformation. In 1862 the beam of the pumping engine at the Hartley Colliery collapsed and fell into the shaft, completely blocking it and entombing the unfortunate miners. Had there been a second shaft to the mine the terrible death-roll would have been averted. The public outcry that arose resulted in the law being amended to require all collieries henceforth to have an emergency shaft, and thus the practice of constructing two shafts per mine became compulsory.

Some mines, indeed, have three shafts and one of the earliest examples of this was a colliery opened up near Barnsley sometime between 1840 and 1850. This mine was provided with two main shafts several yards apart, and a third but shorter shaft close to the second. The first or "downcast" shaft was 9 ft. in diameter for 230 ft. down and then 10 ft. 9 in. in diameter to the bottom of the working, while the "upcast" shaft was uniformly 10 ft. 9 in. in diameter. The third shaft was only sunk as far as water was found to percolate into the workings and was used solely as a well for the water, which was pumped up thence by a steam engine. Great interest was centred upon this colliery at the time it came into being as the shafts were known to have been carried to the then record depth of 848 ft.—almost 300 ft. deeper than any other colliery then in existence in Great Britain.

Nowadays the shafts of many coal mines penetrate to depths of more than 3,000 ft., while in Belgium shaft-sinking has been carried on to within a few feet of the 4,000 figure. Modern mine shafts are constructed with a diameter of 16 ft. to 23 ft. according to the amount of coal it is anticipated will be brought up when the colliery is working. The downcast and upcast shafts are often a considerable distance apart, for the underground workings of a modern mine are very extensive.

Modern Pithead Gear

The temporary winding gear erected for hoisting up the debris during the excavation of a new shaft is so placed as not to interfere with the building up of the permanent pithead gear. This permanent structure, almost pyramidical in shape and surmounted by a pair of large naked pulleys, is an unpicturesque but familiar sight wherever there are coal mines.

In many coal mines opened up during recent times the customary timber framework of the headgear has been omitted in favour of a lattice-work of steel girders. Although it is costlier to erect, steel headgear is regarded as being economical in the long run, for it will appreciably outlive a wooden structure. In addition it is safer and practically fireproof, and will enable heavy loads to be handled with greater speed than a timber headgear could withstand.

The diameter of the winding pulleys is usually that of the drum of the winding engine, to which we shall refer later, and except where the loads borne are very heavy, the boss and rim of each pulley is made of cast iron. For heavy work steel or wrought iron takes the place of cast iron.

A main shaft is divided into two semi-circular compartments by a steel lattice-work partition, and each compartment accommodates one pit cage, a steel box-like structure generally 4 ft. broad and of a length and height of about 12 ft. This size of cage usually contains two decks for the trucks, although cages of greater height fitted with three or four decks are in use. The miners who travel up and down in the cages are protected by a roof over the top deck and gates fitted at the deck ends which, until comparatively recent times, were not provided with any barrier at all. At the top of each cage a short length of chain leads off from each corner and the various lengths are joined together by a shackle to which the winding rope is attached.

The steel winding ropes pass up from the tops of the cages to the large winding pulleys already mentioned, and thence overhead to the drum of the winding engine housed in a building some distance away.

Spiral-shaped winding drums are in use at a number of collieries, but cylindrical drums are the most common and these are sometimes as large as 24 ft. in diameter. Steel framework composes the sides, and the thickness of the drum is represented by a broad timber groove in which the two coils of ropes are accommodated alongside each other. One rope passes on to the drum at the top and the other winds on from the underside. Thus they coil in opposite directions, with the result that as one rope is being paid out the other is being drawn in.

In addition to steam and foot brakes, all winding engines are equipped nowadays with an automatic safety device that shuts off the steam and applies a brake immediately the speed of the engine exceeds a prescribed limit. Electrically-driven winding plant is now installed at one or two collieries in this country.

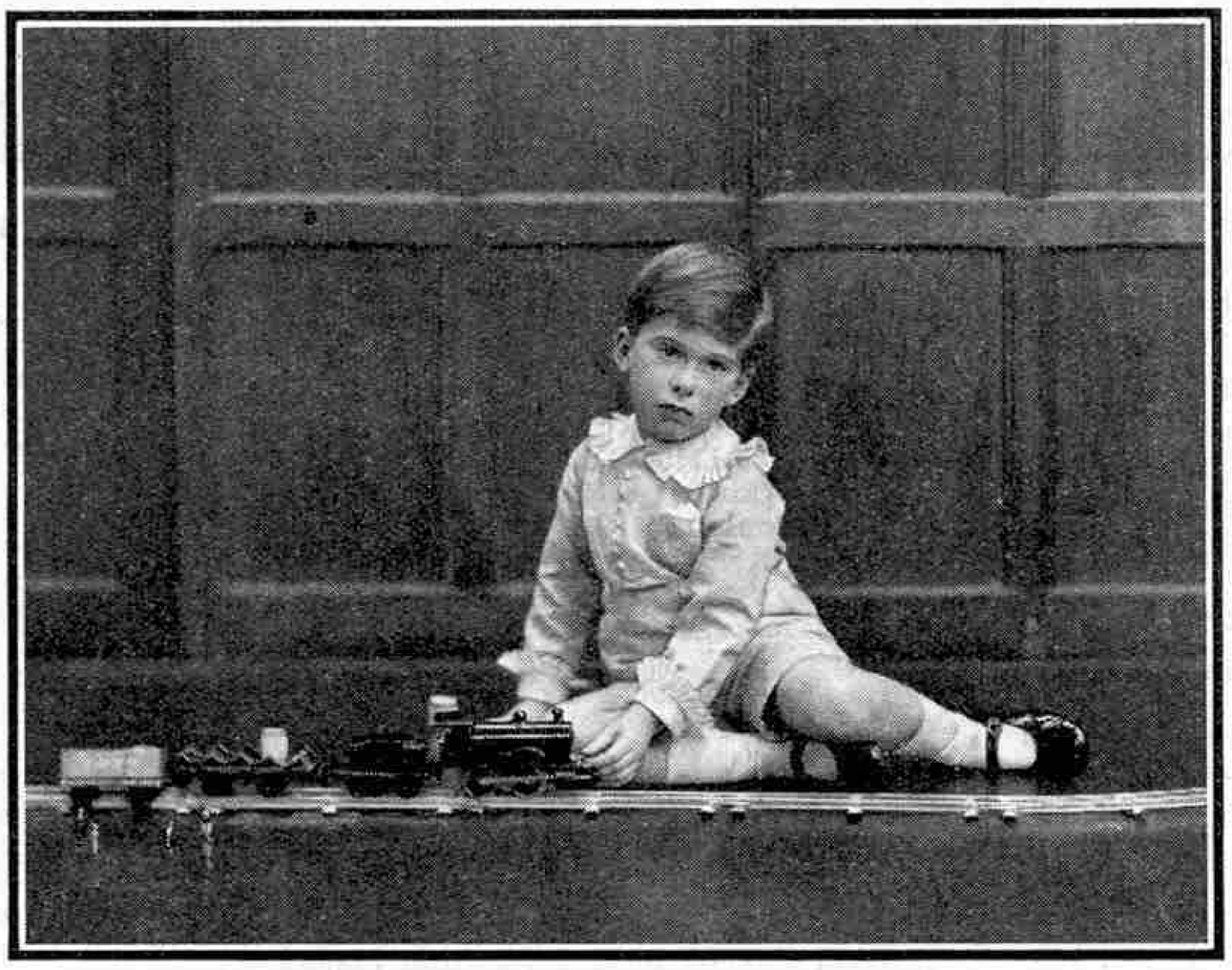
Ventilating the Mine

Adequate ventilation of the extensive and deep workings of a modern coal mine is of very great importance, and everything possible is done to ensure the highest degree of efficiency in this respect. The system of ventilation adopted consists of drawing fresh air down into the mine by way of the downcast shaft, feeding it along a series of air passages called "intake" roads to the various levels and workings, and recovering used air, which in turn is drawn through a series of "return" roads to the upcast shaft, at the head of which it is discharged. The terms "downcast" and "upcast" thus indicate the course followed by the air through the two main shafts.

At one time this circulation of air was effected by maintaining a large fire at the foot of the upcast shaft. The air thereabouts on becoming heated rose, and its place was taken by fresh air entering from the downcast shaft. Such a method has obvious dangers, however, and on occasions serious mine fires were traced to the contact of gases with the open furnaces.

Nowadays, ventilation is carried out by means of a powerful turbine-driven centrifugal fan housed in a special building known as the "fan house," adjoining the head of the upcast shaft. These huge fans are of an enclosed type and are often capable of drawing one million cubic feet of air per minute! The fan is erected at the head of a sloping air-passage that merges into the upcast shaft some distance down the latter. Airtight doors ensure that only the air of the upcast shaft reaches the fan

A Royal Birthday



Our photograph shows the Hon. George H. Lascelles, eldest son and heir of Viscount Lascelles and Princess Mary, Viscountess Lascelles.
The Hon. George, who celebrated his fourth birthday recently, is extremely interested in toys of a mechanical nature and has a decided preference for engines and motor cars, the works of which can be explored with the object of finding out exactly "how the wheels go round!"

Ostend Air Express

A new Imperial Airways service is to be operated with 14-seater Handley-Page Napier air liners between Croydon and Ostend. The Casino Air Express, as it is to be called, will leave Croydon at 2 p.m. daily and depart from Ostend at 9 a.m. on the following day, thus allowing business men to spend a night in Ostend and to return to London early next day.

* * * *

Croydon Aerodrome Returns

The Croydon traffic returns show that a steady increase has taken place during past years. During 1926 about 26,500 passengers were carried, 16,000 travelling in Imperial Airways machines and the remainder in French, Dutch, Belgian, and occasionally German machines. During August the record for any week was broken, 1,313 passengers using the port. Previously the highest record was 1,125. The total number of arrivals and departures of machines during the year was 5,446.

* * * *

Canadian Aeroplane Harbours

It is stated that the Canadian Department of Defence are asking the Premiers of the Provinces and the Mayors of the leading cities to consider suitable sites for air harbours. The first step probably will be the inauguration of air mail services between the Atlantic coast and the lower St. Lawrence and Montreal, possibly extending to Toronto and Winnipeg.

A private company, the Canadian Trans-Continental Airways Co., has been registered in Quebec, to carry on a regular flying boat service between Chicoutimi and Toronto. Riviere du Loup, Quebec, Three Rivers, Montreal and Ottawa will be calling places en route. The service will probably begin operations in June of this year.

* * * *

A Fog Dissipator

An invention of interest to aviators is a new apparatus which, it is claimed, can clear a path 1,000 ft. in height and 2,000 ft. in width through dense fog. It is stated that the apparatus throws a blast of air charged with electricity, causing the fog to be precipitated as rain.

* * * *

German Civil Flying

In the nine months of 1926 during which the Luft Hansa operated, 56,268 passengers, 384 metric tons of baggage and 258½ metric tons of postal matter and newspapers were carried. These figures show an increase of 50.3 per cent. in passengers, 115 per cent. in baggage and 86.4 per cent. in postal matter over the figures for 1925.

The total distance covered during this period was 6,141,479 km. (about 3,816,000 miles), against 4,949,661 km. (about 3,073,740 miles) in 1925. In addition, the total length of the network of airways was increased during 1926 from 17,574 km. (10,813 miles), to 20,408 km. (12,673 miles).

The figure quoted for 1925 are those of the Aero Lloyd and Junkers transport companies, the amalgamation of which in April 1926 formed the Luft Hansa.

* * * *

New All-Metal Flying Boat

M. Louis Paulhan, who in 1910 won a prize of £10,000 for a flight from London to Manchester, is collaborating at Marseilles with M. Pilliard, a French engineer, in the production of a three-engined flying boat. The machine is being constructed entirely of steel and duralumin under the guidance of M. Pilliard, who is an expert upon the subject of light metals. A total of 1,300 h.p. will be developed and it is anticipated that it will be possible to carry a cargo of two tons when flying against a strong head-wind. Arrangements have been made by which five machine-guns can be mounted for naval purposes.

* * * *

World Tour by Air

Mr. Lester D. Gardner, publisher of the New York paper *"Aviation,"* is to attempt to tour the world, chiefly by means of aircraft, in 24 days. He will travel first from New York to San Francisco by the Transcontinental service shortly to be opened. Thence he will cross to Peking by Pacific steamer and connect with new Japanese air lines that join Peking and Korea. From Peking to Moscow he will travel by the first machine on the Peking-Moscow air line, and his journey to England will then be by old-established routes.

Two Americans, Messrs. Evans and Wells, toured the world last year in 28 days 14 hours 36.5 seconds.

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A new air service between Amsterdam-Southampton is being planned and probably will be inaugurated shortly. It is to be operated by the Royal Dutch Air Service Company, which maintains the daily Amsterdam-London service.

Warsaw-Tokyo Flight

Capt. B. Orlinski and Colour-Sjt. Kubiak of the Polish Military Air Service have flown from Warsaw to Tokyo and back on a Breguet XIX. biplane with a 450 h.p. Lorraine-Dietrich engine, covering about 12,000 miles. Tremendous difficulties were overcome by these aviators. At Moscow, 714 miles from Warsaw, it was found that the airscrew was burst or cracked. Capt. Orlinski knew that unless he returned to Warsaw he would be unable to change the screw until he reached Tokyo, and he chose Tokyo. Great difficulties caused by a storm were overcome, and eventually Tokyo was reached.

On the return journey the weather was so bad that three attempts were made before the Sea of Japan was crossed. At Hai-ju an oil pipe was found to be leaking, and this was bound up with tape. At Byrka, however, the airmen were forced to land to repair the pipe. A sudden gust of wind lifted the machine and caused it to crash into a fence some 30 yards away, breaking the bottom left-hand plane. The other bottom plane was stripped to restore the balance of the machine and the flight was continued.

* * * *

King's Cup Race

The King has expressed his approval of the conditions for this year's Cup Race recently submitted by the Royal Aero Club. The race is to be over a course of approximately 525 miles, divided into three stages of 175 miles each. Each of these stages will be made up of seven laps of the circuit and each machine must alight at the end of each seven laps. After a careful survey a circuit of 25 miles has been chosen near Bournemouth.

The race will take place on August Bank Holiday and will continue only during the one day.

* * * *

Australia-Tasmania Air Services

Negotiations are in progress between a flying company and the Commonwealth and Tasmanian Governments with a view to establishing an air service between Victoria and Tasmania. The service will be operated along a route from Melbourne, via Wilsons Promontory, Hogan and Kent Islands, Baron and Clark Islands, Cape Portland, Low Head, and Launceston. This is known as the Eastern Route and is 293 miles in length. The company concerned will probably use modern 12-seater three-engined metal flying boats.

New World's Records

Several air records have been broken recently by a German pilot Steindorf, flying a three-engined 720 h.p. Rohrbach machine.

With a cargo weighing one ton, Steindorf flew 500 kilometres (about 312 miles) and attained a maximum speed of 165 km. per hour (about 103 m.p.h.), long distance and speed records for this class. With a cargo of two tons, four records were established, a flight duration record of 4 hrs. 18 mins., a distance record of 600 km. (about 375 miles) and two speed records—173.5 km. per hour for a distance of 100 km. (approximately 108 m.p.h. for a distance of 60 miles), and 165 km. per hour for a distance of 600 km. (approximately 103 m.p.h. for a distance of 312 miles).

These records were established under the supervision of the Official Aerial Association at Stooken Aerodrome, near Berlin, but are subject to the official confirmation and recognition of the *Fédération Aéronautique Internationale.*

* * *

A new Cherbourg-London record has been created by Captain W. J. R. Hinchliffe, D.F.C., flying an Imperial Airways special. His time on this trip was 76 minutes and, although it is not yet confirmed, this is stated to be the fastest time made between the two aerodromes.

* * * *

New American Airship

The United States House of Representatives have passed a Bill providing for the construction of a dirigible to replace the wrecked "*Shenandoah.*" It is estimated that the airship will cost £900,000.

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Toulouse-Morocco Service

The Toulouse-Morocco service, which has been in operation since September 1919, and was extended from Casablanca to Dakar in July, 1925, has proved a success chiefly from a mail-carrying point of view. In 1919, the number of letters carried was 9,124 as against 1,407,352 in 1922; 7,502,191 in 1925, and 6,149,489 in 1926. Altogether the huge total of 22,563,478 letters has been carried by this service. The figure for 1925 represents an average of 20,554 letters per day, or one letter per white person in Morocco every five days.

* * * *

The Schneider Trophy

The Schneider International Seaplane Contest for 1927 is to be held at Venice on 1st September. If, in the opinion of the Committee, weather conditions are too bad for racing, the contest may be postponed until any date previous to 15th November.

Trans-Atlantic Air Mail Service

A weekly air mail service, forming an extension of the Toulouse-Casablanca-Dakar service which has been in operation for several years, is to be operated between Europe and Argentina. The proposed extension route is by flying boat to the Cape Verde Islands, by steamer to the island of Fernando Noronha off the coast of Brazil, and thence by aeroplane to Buenos Aires. The entire journey will take 7½ days but, by the substitution of a flying-boat service for the steamer between the Cape Verde Islands and Fernando Noronha, it is hoped later to cut this down to four days.

* * * *

Petrol Pumps for Aeroplanes

Mr. J. Leeming, during a recent flight from Chester to Manchester, discovered that the petrol tanks of his D.H. Moth were almost empty. He followed the main road for some distance and then noticed a motor-garage conveniently situated near a field. Landing in the field, he taxied across to the garage and astonished the proprietor by asking for six gallons of petrol. After filling up from a petrol pump Mr. Leeming wheeled the machine away from the building and resumed his flight.

It will be remembered that Mr. Leeming succeeded recently in landing his Moth on the summit of Helvellyn.

* * * *

Atlantic Airship Flight

General Nobile, who piloted the airship "*Norge*" across the North Pole, has been ordered by the Italian Premier to make preparations for a flight across the South Atlantic from Rome to Buenos Aires. The vessel, at present in course of construction, is to be a semi-rigid airship with a gas capacity of 1,765,500 cu. ft. General Nobile is supervising the construction and it is anticipated that the ship will be completed next year.

A 16-year Old Pilot

Robin Sanders Clark who, although only 16 years of age, has already learned to fly. He took his lessons at Stag Lane Aerodrome where, as our readers will remember, the de Havilland Aircraft Co. Ltd. have their works. Robin is certainly the youngest pilot in Great Britain, although in America there is a boy pilot who is two years younger

Seaplane Speed Records

The seaplane speed records set up in 1926 by Major Mario di Bernardi have recently received the confirmation of the *Fédération Aéronautique Internationale.* Previous to Major Bernardi's success the maximum speed ever attained by a seaplane under official conditions and supervision was 395.439 km. per hour and the maximum average speed over a distance of 100 km. was 378.827 km. per hour. These records were held by Lieut. J. H. Doolittle, U.S.A.C. Major Bernardi's records are a maximum speed of 416.618 km. p.h. (258.873 m.p.h.), and an average speed of 399.423 km. p.h. (248.198 m.p.h.) over 100 km.

Although these records were set up by an Italian flying an Italian machine, a Macchi M.39, fitted with an Italian engine, an 800 h.p. Fiat, they are credited to the United States because they were set up at Hampton Roads, Norfolk, Va.

* * *

New South African Mail Services

Negotiations have been opened by the Union Government of South Africa with a view to inaugurating a mail service which, it is anticipated, will shorten by four days the time taken for mails to cross between England and the Cape. Walfisch Bay will probably be the terminus for the service, all mails being taken there before embarkation.

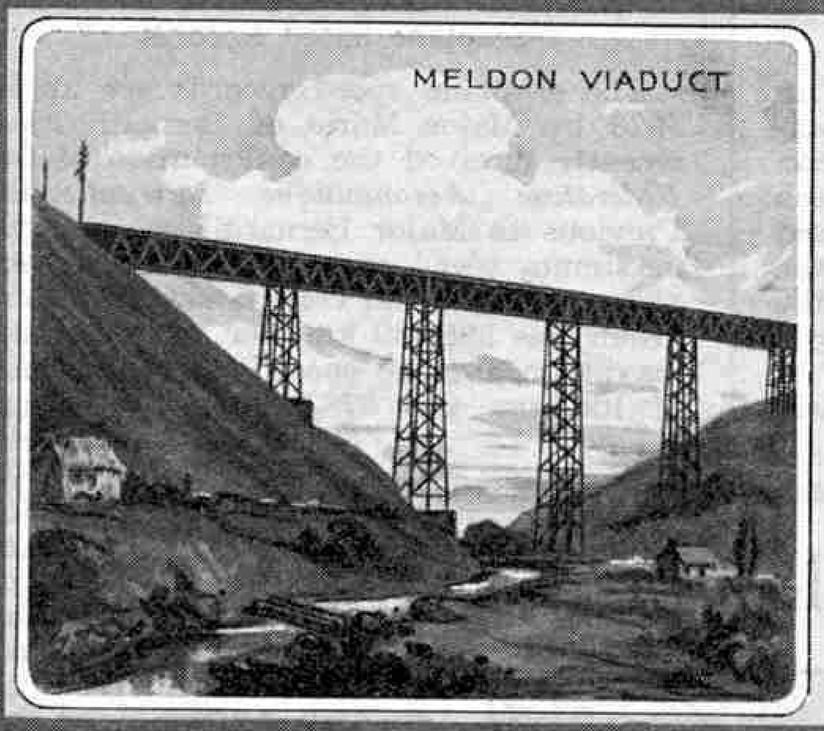
The Union Castle Line, at present the mail-carrying contractors, do not use Walfisch Bay as a port of call, despite the fact that this region is only 12 hours' journey by air from Johannesburg and Pretoria, and is three days nearer England than Cape Town. This company would require an additional subsidy if it were called upon to use Walfisch Bay as a calling port, as the fulfilment of such a demand would involve considerable expense.

Experimental mail services between Durban and Cape Town showed that while, from a flying point of view, conditions were very favourable, commercially and financially the service received very little support. Major Miller, a member of the South African Civil Aviation Board, has now obtained the necessary financial support, however, amounting to £30,000, partly in England and partly in America. It is intended to use this money to finance a mail service between Johannesburg and Durban.

* * * *

New Helicopter Design

A new helicopter has been invented by F. E. Loudy, an American. In principle the "airfoils," as the lifting devices are called, act by means of a rotary fan that draws in air and causes the outflowing air to exert a lifting force. No information regarding performance has been obtained.



Famous Trains

and the Routes over which they run

by

CECIL. J. ALLEN. M.Inst. T. Etc.

IV.—THE "ATLANTIC COAST EXPRESS," SOUTHERN RAILWAY

ALTHOUGH the famous express leaving Waterloo at eleven o'clock in the morning can look back on a long history—much longer, indeed, than that of the rival "*Cornish Riviera Limited*" express out of Paddington—it is barely for a year past that it has enjoyed the dignity of a name. It is an excellent name, too. "*Atlantic Coast Express*" aptly sums up the fact that this train, ere its journey is done, will have distributed parts of itself over much of the coast washed by the mighty Atlantic Ocean, both north and south of Devon and in North Cornwall as well.

We may well pause for a look at Waterloo terminus before we pass through the barrier to our train. Waterloo, once the most awkward and inconvenient of all London termini, an invariable topic for comic papers, a "maze" where one might hunt for a long, long time before running the right train to earth—Waterloo has now developed into the biggest and finest of all our stations. It was the fact that so many additions had been tacked on to the original Waterloo—four in all since the first opening in 1848—that made it such a labyrinth in days gone by. Now, by a marvellous feat of engineering, the new station has been built round and over the original, without any interruption of its enormous traffic.

The New Waterloo

Apart from the arresting frontage of the station, its most remarkable feature is the vast "concourse," or circulating space for passengers, which extends almost across the whole width of the station. At the back of this are the offices, and at the opposite side the platform entrances. The old station on the Windsor side—the most recent of all the "additions" to the original Waterloo, opened in 1912—was really the first instalment of the new Waterloo, and so has been left in its existing condition. This portion has six platforms. The rest of the station, covered by one lofty "ridge and furrow" glass roof right across from one side to the other, has 15 platforms, making a total of 21 in all. Both in this respect and in respect of its covered area of 24½ acres, Waterloo holds the record for British stations. Every day it handles just under 1,200 passenger trains in the 24 hours.

Now let us pass through on to our platform. During the height of the summer, the traffic to the coast is so heavy that one "*Atlantic Coast Express*" can far from provide room for all those who desire to travel by it. Two trains are then run daily, except on Saturdays, when the number swells to five or even six in all. But as we are at present in the spring of the year, we shall find every one of the destinations of this famous "flier" served by one striking assemblage of vehicles. First to leave us are the two rear coaches, the hindmost labelled "Sidmouth" and the next one "Exmouth," although we shall travel 159½ miles together—to Sidmouth Junction—before parting company.

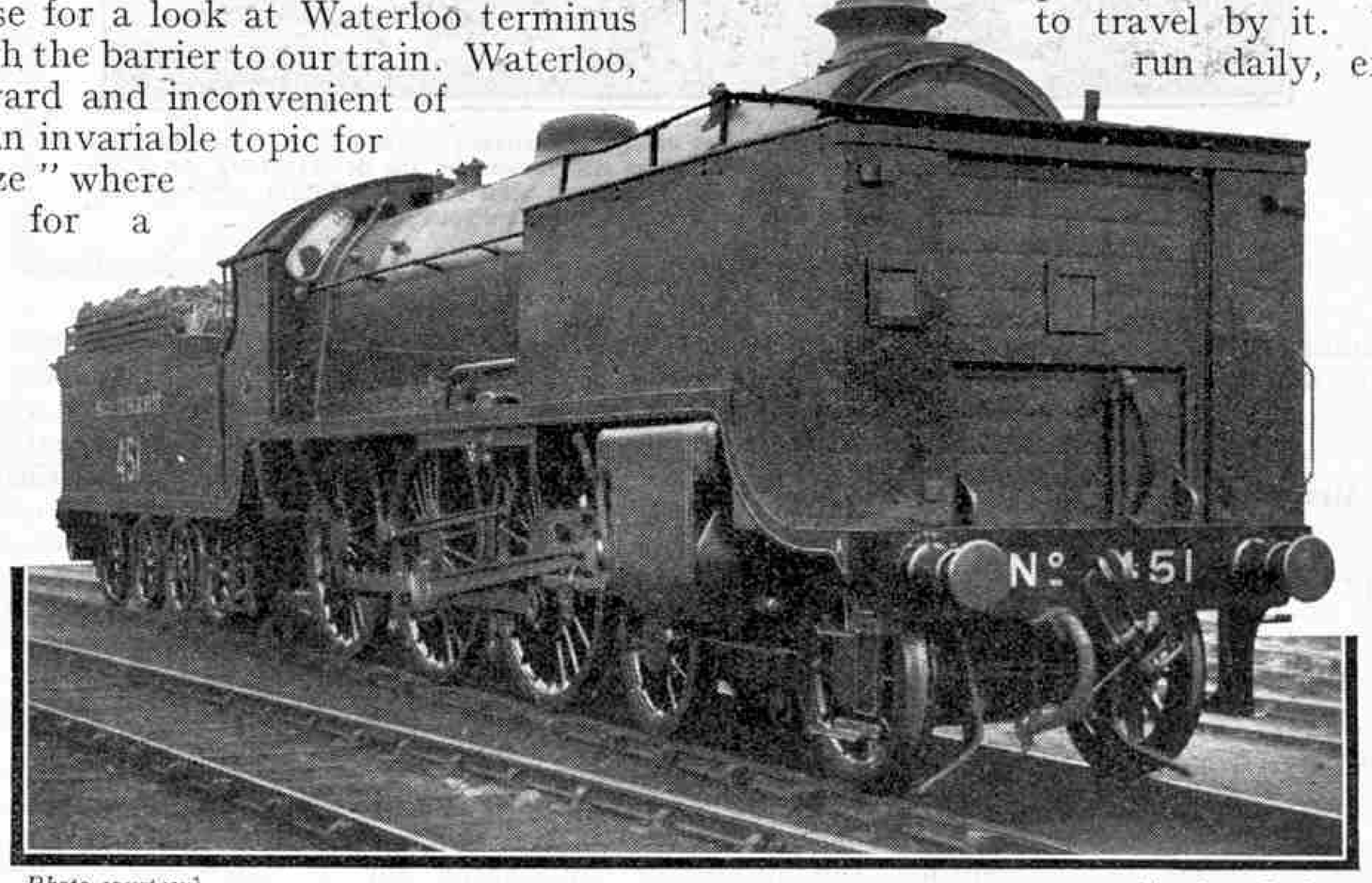


Photo courtesy [*Southern Railway*

"King Arthur" class 4-6-0 engine "Sir Lamorak," equipped with indicating shelter for experimental running on the "Atlantic Coast Express" between Waterloo and Salisbury

The big break-up of the train takes place at Exeter. Third coach from the rear we find the restaurant car, which is detached at Exeter; and next to that come in succession coaches for Bude, Padstow and Plymouth, which are going on together as far as Okehampton, high up on the slopes of Dartmoor. Then we find a coach for Torrington and, last of all, next to the engine, the real "body" of the train—three coaches destined for Ilfracombe. The Ilfracombe and Torrington portions will journey along together as far as Barnstaple. So the complete train consists of eight parts, respectively for Ilfracombe, Torrington, Plymouth, Padstow, Bude, Exeter, Exmouth and Sidmouth.

Steel-panelled Bogie Stock

Probably all the coaches will be of the latest steel-panelled bogie stock, in its handsome green livery. The Ilfracombe portion is made up of two third-class brakes and a first and third class "composite;" all the others, save the restaurant car, are "composite brakes"—that is to say, coaches with four third-class and two first-class compartments, and a small guard's brake. A singular result of such a formation as this is the exceptional amount of first-class accommodation. One smoking and one non-smoking first must be provided in each portion, so that there are nearly half as many first-class as third-class compartments, which makes the travel exceptionally comfortable for the first-class people. These are heavy coaches. The composites weigh 32 tons each and the third brakes 30 tons, so that, inclusive of the 36-ton restaurant car, the 10-coach train turns the scale at 320 tons. With a normal complement of passengers and luggage, the engine may be expected to have a load behind him of 335 to 340 tons; but in summer the loads are often round about the 400-ton mark.

Photo [*F. E. Mackay*

Down "Atlantic Coast Express" in Clapham Cutting, Southern Railway. 4-6-0 engine No. 775 "Sir Agravaine," of the "King Arthur" class with latest type of cab and tender

We need be in little doubt as to what type of locomotive we shall find at the head of the train. We may be fortunate enough, of course, to run across the new 4-cylinder 4–6–0 giant, "*Lord Nelson*," but he is at present the only one of his type, and as he is engaged in making the experimental runs over various parts of the Southern system, it is a hundred to one that our engine will be one of the well-known "King Arthur" type. And who could be better suited to whirling us away to the "King Arthur" country than one of the "Knights of the Round Table?"

Fine Performances of "King Arthur" Engines

It is difficult to lay one's finger on the precise secret of the success of these remarkable engines. Almost every week, in connection with my series of articles in the "*Railway Magazine*," entitled "*British Locomotive Practice and Performance*," I receive from readers who have been using their watches while travelling some new record of "King Arthur" performance. Maximum speeds of 90 miles an hour; sustained speeds of 65 to 70 miles an hour over long sections of favourable track; splendid hill-climbing up the heavy grades of the West Country, whose acquaintance we shall make in a moment—nothing seems to come amiss to them.

In one very important respect their designer, Mr. Mansell, who has developed them from the general lines of the previous 736-755 series, designed by Mr. Urie, has followed Great Western practice; and that is in the use of a long travel for the piston-valves, which has a vital bearing on the work of the engines, as it enables them to be run with a wide-open regulator and a short cut-off, as Great Western drivers are so fond of doing. And rightly, for it is the most efficient way in which they could possibly use their steam, provided that the engine has been designed in such a manner as to respond to the treatment.

Beyond this the "King Arthur" is not an enormously big engine, as our modern engines go, nor, as you will see in the table of dimensions reproduced here, do the two 20½ in. by 28 in. cylinders give—on paper—a very high tractive effort. But the axiom in locomotive work is "handsome is as handsome does," and this certainly describes "King Arthur" performance.

Well, the time has now undoubtedly come to start, and we must therefore take our places in the train. Out of Waterloo, where there is for a short distance a fairly steep rising gradient, the engine which brought in our empty coaches will probably assist us by a friendly push in the rear, but will not venture much further out than the end of the platform. Our speed will then rise fairly rapidly until, at the bottom of the slight dip between Vauxhall and Clapham Junction, we may expect to be travelling at 50 miles an hour, or slightly over. As the Brighton section from Victoria flies over our heads and then comes down to join us on our left, we cannot fail to be impressed with the enormous width of parallel trackage. So far as parallel running lines are concerned, apart from sidings, there are probably more here than anywhere else in the country.

Busiest Station in Great Britain

Seven minutes after our exit from Waterloo we are through Clapham Junction, where the Brighton main line bears away from us on the left, after thus keeping us company for about a mile. Clapham Junction is, without any question, the busiest station in Great Britain and probably in the world. It has 17 platforms, covers 24¼ acres, or if all the sidings be included, 34¾ acres, and deals with no less than 1,730 trains every 24 hours. The majority of these are now electrically operated, by the third-rail system on the South Western side of the station and by the overhead system on the Brighton side.

For the first 20½ miles of its journey our "King Arthur" locomotive has a fairly level route to traverse. The line rises on modest gradients from Clapham to

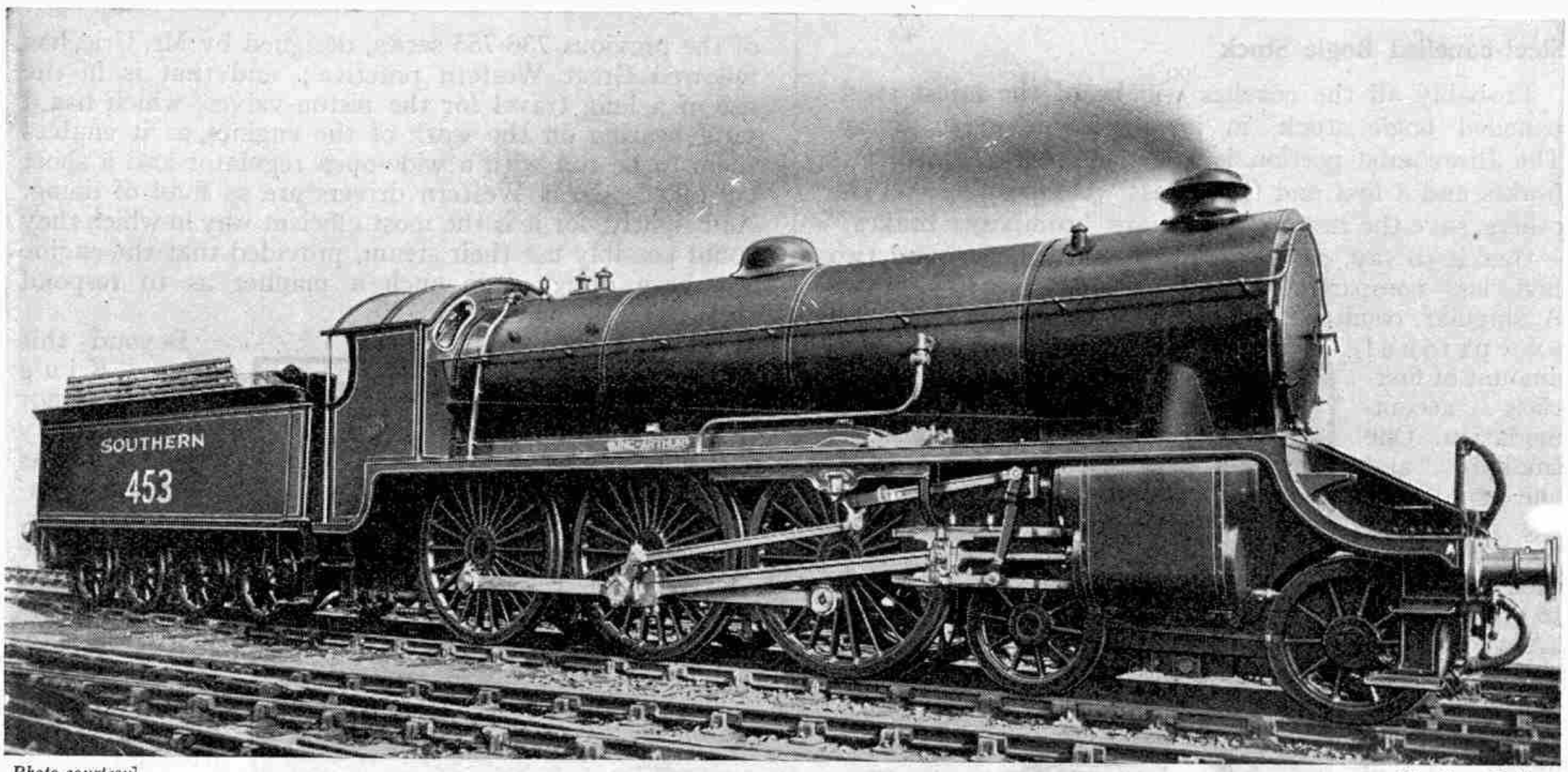


Photo courtesy] [*Southern Railway*

The Southern Railway 4-6-0 engine "King Arthur" which gave its name to the class

Wimbledon, is dead level from there to beyond Surbiton, whence it falls slightly past Hampton Court Junction to Esher; on this fall we may expect an increase of speed well above the "sixty" line, to about 67 or so an hour. To the junction, 13½ miles out of Waterloo, we are allowed 18½ min. in the working time-table, the precision of the odd half-minute being necessary in order to fit the expresses in with the very frequent electric trains.

Use of "Flying" Junctions

We may notice here how the Hampton Court down line is carried over the main line by a "flying" junction, so obviating the obstruction that would be caused had the Hampton Court trains to cross on the level the up and down main lines, and the up slow line as well. You see the same principle operating at the junctions at Raynes Park, Malden, Byfleet, Pirbright, Sturt Lane and Worting, the lay-out of all of which helps to prevent the expresses from getting delayed by signal checks.

By now we are descending the 1¼ miles past Weybridge to Byfleet Junction, and are probably doing 67 or 68 miles an hour. The driver would tell you, in his own expressive language, that the engine is "getting hold of 'em," which is just as well, for directly we have skirted on the left the Brooklands motor track—and very likely have done a "neck-and-neck" for half-a-mile or so with some racing car that is being tried out—our "King Arthur" is faced with some hard work.

For the next 32 miles, indeed, there is very little intermission in the climbing. Not that it is steep; the 10½ miles from Byfleet Junction to mile-post 31 steepen gradually from 1 in 388 to 1 in 298; then, after six miles level past Farnborough and Fleet, come three miles up at 1 in 337 to Winchfield; then six miles more level or slightly undulating bring us to the five miles up at 1 in 249 past Basingstoke to Worting Junction, where we part company with the Southampton and Bournemouth line.

These are not heavy grades, as I have said, but we must remember that our locomotive is scheduled to run up them at an average speed of nearly 56 m.p.h.—from Woking to Worting—which means uninterrupted hard work, or "collar-work," as it is sometimes called, to borrow for the iron horse a metaphor from his flesh-and-blood brother on the roads.

By Woking speed will have dropped to 60 miles an hour. We have now covered 24½ miles from Waterloo in 29 minutes. Between here and Basingstoke we notice, for a distance of over 20 miles, a stretch of entirely automatic signalling. The signals are carried on lattice girder bridges over all four lines, and by electro-pneumatic mechanism are worked by the trains themselves, except, of course, at the junctions and stations, where the points are operated from signal-boxes. By automatic signalling it is possible to work high-speed trains at very close intervals.

One of the Fastest Stretches on the Southern System

This is, in fact, one of the fastest stretches on the Southern system, the up expresses, in certain cases, being only allowed 21½ min. to cover the 23½ miles between Basingstoke and Woking, and not infrequently covering the distance in under 20 minutes. On the inaugural up-run of "*Lord Nelson*," described in the "*Meccano Magazine*" for February, you will see that the time over this "galloping ground" was five seconds over 19 minutes.

We shall probably breast the miniature "summit" at mile-post 31 at round about 50 miles an hour, and from Farnborough nearly to Basingstoke we shall run at sixty, or slightly over. The booked time to Basingstoke, 48 miles, is 54 minutes, and three minutes later we should be past Worting Junction, 50½ miles out, at the summit point of our climbing and the end of the engine's hardest efforts. For after Oakley, a couple of miles further on, the line falls, gently at first, but quite steeply at last, for the next 13 miles. Were we on the footplate we should now see the cut-off brought well back and the regulator partly closed.

From a minimum rate of 47 m.p.h. or so at Worting our acceleration at first will be relatively slow, but by the time we pass Overton—where the paper for Bank of England notes is made at the big factory on the right of the line—we shall be doing 60 an hour and more. Through Hurstbourne we dash at well over 70 and then, after negotiating a short rise, the 1 in 178 down to near Andover will quite likely witness the first 80-mile-an-hour maximum of our journey, if the driver be so minded.

The impetus of this swift flight will help to carry us up the seven steeply-rising miles to Grateley, finishing with 2¾ at 1 in 165 and bringing the speed down to about 50 an hour again. Then follows a glorious downward spin through the heart of the Wiltshire Downs, with the slender spire of Salisbury Cathedral in sight dead ahead—again we may touch a top speed anywhere between 75 and 80 miles an hour—until we thread a short tunnel and draw up at Salisbury platform.

Leading Dimensions of Southern Rly. 2-cylinder 4-6-0 Engines, "King Arthur" Class

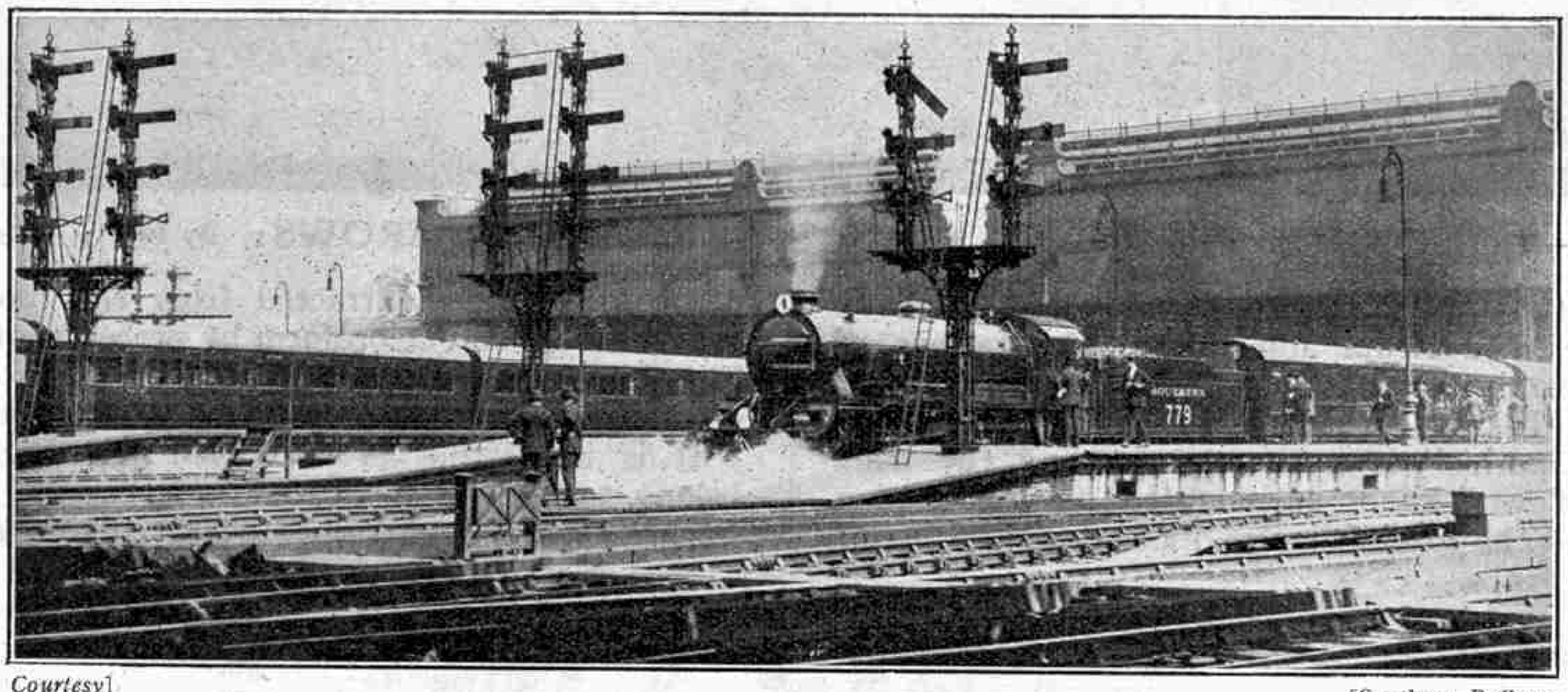
Cylinders, Diameter	20½ in.
„ Stroke	28 in.
Driving Wheels, Diameter ...	6 ft. 7 in.
Heating Surface, Fire Tubes ...	1,252 sq. ft.
„ „ Flue „ ...	464 „
„ „ Firebox	162 „
„ „ Superheater ...	337 „
„ „ Total	2,215 „
Firegrate Area	30 „
Working Steam Pressure ...	200 lb. per sq. in.
Tractive Effort at 85% Wkg. Press.	25,450 lb.
Water Capacity of New Type Tender,	5,000 galls.
Coal „ „ „	5 tons
Adhesion Weight of Engine ...	60 tons
Total „ „ (in working order)	81 „
„ „ Engine and Tender (full)	138½ „
Length of Engine and Tender (over buffers)	64 ft. 8 in.

"Lopping Off" Minutes

For the 83½ miles from Waterloo the time-table shows exactly an hour-and-a-half, but "King Arthur" drivers are very fond of lopping minutes off this schedule, and quite likely we shall have taken 89 or 88 minutes, or even less. On one experimental run not so very long ago the engine "*Sir Lamorak*," which figures in one of my illustrations, succeeded in cutting the time to 75 minutes, which was a very remarkable achievement. But this is really a secret, and ought not to be spoken about above a whisper!

At Salisbury we shall probably lose our London "King Arthur" and get another for the next 88-mile stage of our journey to Exeter. In the summer, however, the engines sometimes work right through, although the engine crews are changed at Salisbury.

The switchback over which we have just come during the last 25 miles of our journey is a foreshadowing of the far steeper switchback ahead of us.



Courtesy] [*Southern Railway*

The "Atlantic Coast Express" (first portion) leaving Waterloo for North Cornwall on its first trip, July 19th. The second portion (Ilfracombe) is in background, by No. 11 Platform

Higher average speeds are run over the Salisbury-Exeter length of the Southern, in proportion to the severity of the gradients covered, than could be instanced on any other railway in the world, in all probability. Although there are long stretches of 1 in 80, yet the average booked speed of the "*Atlantic Coast Express*" from Exeter to Salisbury, during the summer months, is no less than 55 m.p.h., and but a shade less in our direction of running. In the winter there is an additional stop to make at Sidmouth Junction, but the speed to that point is just as high.

These average speeds are only made possible because of the splendid lay-out of this route, which permits of practically unlimited downhill speeds, and the latter are in their turn of material assistance to the engines in climbing the uphill grades. Thus we may look out, not only for one or two, but for more like half-a-dozen very high maxima, at certain well-defined places.

Out of Salisbury we climb, gradually at first but then more steeply, for 17¼ miles to Semley, only the final two being as steep as 1 in 145. Then, suddenly, as though we were dropping down the roof of a house, there comes a thrilling speed-up down to Gillingham, our speed rising in four miles probably to the "eighty" mark. Two miles' ascent to Gillingham Tunnel, and we drop again sharply to Abbey Ford. Then comes Templecombe bank—with a mile at 1 in 80 and 1½ in 160—which will bring us down to between 45 and 40 an hour. A short "plateau" past Milborne Port, and there follows another hurricane descent into Sherborne, with a second "eighty," very likely.

From here we shall traverse 5½ miles of undulations to Yeovil Junction at high speed, the 39 miles from Salisbury to this point having taken us about 44 or 45 minutes. Sutton Bingham bank—3½ miles up at between 1 in 220 and 140—now lies ahead, with some subsequent moderate downhill stretches that bring us to the foot of Crewkerne bank. This is very severe, being for 2¾ miles at 1 in 80, and when we have threaded the short tunnel near its summit, our speed will not be much over 30 miles an hour, perhaps 32 or 33.

A Glorious Racing Ground!

But from Hewish onward is one of the most glorious "racing grounds" of the journey—13 miles of uninterrupted downhill, not excessively steep, past Chard Junction and Axminster. The major part of this we shall cover at a speed well above 70 miles an hour, while the driver is at the same time getting his boiler filled up and a good head of steam in preparation for the hardest task the engine has yet faced.

This begins rather less than two miles beyond Axminster. Here the line makes a right-angled turn, from a south-westerly to a north-westerly course, up into the hills, to get through to Honiton. This entails a climb, first of 1¾ miles at 1 in 100 to Seaton Junction, and then of 1 in 80 for no less than 4½ miles, to the Honiton Tunnel, which bores under the crest of the watershed for ¾-mile, the railway still rising at 1 in 132. Actually, in seven miles, the line climbs rather over 400 ft. To go over this summit at a minimum rate of 30 m.p.h. with this load would be a miracle; we may expect a minimum of from 23 to 25 miles an hour, if the weather is good and the rails are not greasy.

Once through the summit tunnel, our "King Arthur" has no further troubles to face. In the summer, when the 11 a.m. from Waterloo makes no stop at Sidmouth Junction, less minutes will probably be taken from Honiton into Exeter than the miles covered. On my last journey but one the locomotive "*Elaine*" touched 85 miles an hour on this descent, but the same engine beat this record in the same week by taking me down the other side of Honiton at a top speed of exactly 90 an hour!

Even in the sharp dip before Sidmouth Junction, however, we may and probably shall get high up into the "seventies," possibly even to 80; and then, after leaving the junction with a trainload less by two coaches, we may expect a final "burst" of 75 to 78 m.p.h. through Broad Clyst. So, after these thrilling experiences, we draw up at Queen Street, Exeter, 171½ miles from Waterloo, at 2.22 p.m. The fastest time in the summer, of the Ilfracombe portion of the train, is 3 hours 13 minutes to Exeter, inclusive of a six minute stop at Salisbury.

Farewell to Our Express

As our "*Atlantic Coast Express*" now breaks up into various parts, we will bid it a reluctant farewell. The Plymouth, Padstow and Bude coaches are going to climb high up the slopes of Dartmoor; beyond Meldon Junction, Okehampton, the first-mentioned of the three will, indeed, go over an altitude of 950 ft. ere it drops to Tavistock and thence into the Tamar valley, so reaching Devonport and Plymouth. Just before Meldon Junction, by the way, is the remarkable lattice girder viaduct which figures in the heading of the present article.

Immediately after the various portions of the train leave Queen Street Station at Exeter, they have to descend the steepest gradient on the whole of the main line. It is only ½-mile long, but the steepness is 1 in 37; it leads down through a short tunnel on to the Great Western main line at St. David's Station, and Great Western metals are used for the next 1¼ miles to Cowley Bridge Junction. In view of the tremendously steep incline just mentioned, all up Southern trains, the "*Atlantic Coast Express*" included, have to be banked in rear from St. David's up to Queen Street, the heavier of them by two 0–6–0 tank engines coupled together.

In this connection it is a singular thing that as in St. David's Station at Exeter—the next stop—the Southern train from Waterloo comes in at the south end of the station and the Great Western train from Paddington at the north end, so at North Road Station at Plymouth the same Southern train arrives from the west and the same Great Western train from the east! That is to say, twice in journeys in the same direction between the same places these two trains can meet each other, in both cases running in opposite directions!

The Ilfracombe and Torrington portions make off up the fertile valley of the Taw to Barnstaple, where they separate. What the Ilfracombe train does not attain in the matter of height, as compared with its Plymouth and Padstow associates, it certainly makes up for in the matter of gradient, for beyond Barnstaple it has to climb at 1 in 40 between Braunton and Mortehoe, finally dropping down to the "Atlantic Coast" at Ilfracombe by a two mile gradient at 1 in 36!

So another day's travel of the "*Atlantic Coast Express*" is brought successfully to a conclusion.

The Outdoor World and its Hidden Beauties

II.—POISONOUS TREES AND PLANTS OF OUR HEDGEROWS: By Eric J. Helsby

LAST month we dealt with the historic Hemlock and the Wild Arum and further illustrations of these two interesting poisonous plants are given this month. In that of the Wild Arum part of the sheath or "spathe" is removed, revealing the male and female flower knobs surmounted by the sloping ring of hairs at the base of the spadix as described in our previous article.

From the Wild Arum we passed to the Woody Nightshade and the Black Nightshade and come now to another poisonous plant of the Nightshade fraternity.

The Deadly Nightshade

The Deadly Nightshade is not a native of the British Isles and such discoveries of it as have been made here have been in the vicinity of old ruins. From this it would appear that such plants have at some remote period been brought from abroad for cultivation in this country. It is regarded as being a native of Southern Europe and Asia, and is to-day also a familiar plant in America.

The Deadly Nightshade yearly throws up new stems to a height of about 3 ft. The leaves, broad and pointed, grow in pairs of one long and one short leaf, the former being about eight inches and the latter roughly three inches in length. In the base of each pair of leaves grows a single bell-shaped flower about one inch in length and of a greenish-purple colour. The subsequent fruit which, if eaten, may lead to serious consequences, is in the form of a beautiful glossy, purple-black berry, similar in size and shape to a cherry, and containing numerous tiny seeds. Each berry is surrounded by five sepals, like a bright green five-pointed star.

This plant is the source of the famous drug "Belladonna," which is extracted from the roots with the aid of alcohol and chloroform by processes of distillation. The drug thereby obtained is in the form of colourless crystals and has many medical applications.

It is interesting to note that the Nightshades all belong to the same natural order as the potato and tomato and it is worth while to obtain some of the flowers and fruits of these respective plants and carefully compare them. The fruits of the potato are injurious and even the tubers, if they become green and bitter through being exposed to the light while growing, develop the poison and are then unfit for food.

A Fine Yew Tree

The Henbane is a relative of the Deadly Nightshade and possesses several interesting features. The leaves are a greyish shade of green and grow to a length of nine or ten inches. They are clothed with numerous soft moist hairs, as also are all the stems and calyx. Each cream-coloured purple-veined flower nestles within a calyx the upper part of which is cleft into five stiff "teeth." These curiously angular calices do not wither when the flower falls away and is replaced by the fruit, but continue to grow, and even increase greatly in size.

The plant is of unattractive appearance and, moreover, has a very repulsive smell, which perhaps explains why instances of Henbane-poisoning are not heard of as frequently as are cases of poisoning from the Deadly Nightshade. Nevertheless, the roots of the Henbane have sometimes been dug up and eaten in mistake for parsnips—with disastrous results to the consumer! An extract from the Henbane was one of the chief potions of the old herbalists and is still used to a limited extent in medicine.

A Poisonous Apple

Another but less common relative of the Nightshade is the Thorn Apple, a foreign plant introduced into this country in 1590. It has several interesting features and is fairly easy to recognise. The plant branches liberally and has irregular-shaped leaves. White trumpet-shaped flowers, neatly fluted, make their appearance in July and the ensuing fruit is a brown colour when ripe. A peculiarity of the fruit is that it is protected by numerous blunt spikes, and it is this characteristic that has given rise to the name Thorn (or thorny) Apple.

The whole plant is powerfully poisonous but, as with some other of the poisonous plants dealt with in our articles, certain parts and qualities may, under correct treatment, be made an aid instead of a menace to health. Thus the Thorn Apple is nowadays cultivated in Britain on account of its seeds and its leaves, the former being used to good effect in a herbal remedy for asthma and bronchitis, while the latter perform a similar function in certain cigarettes.

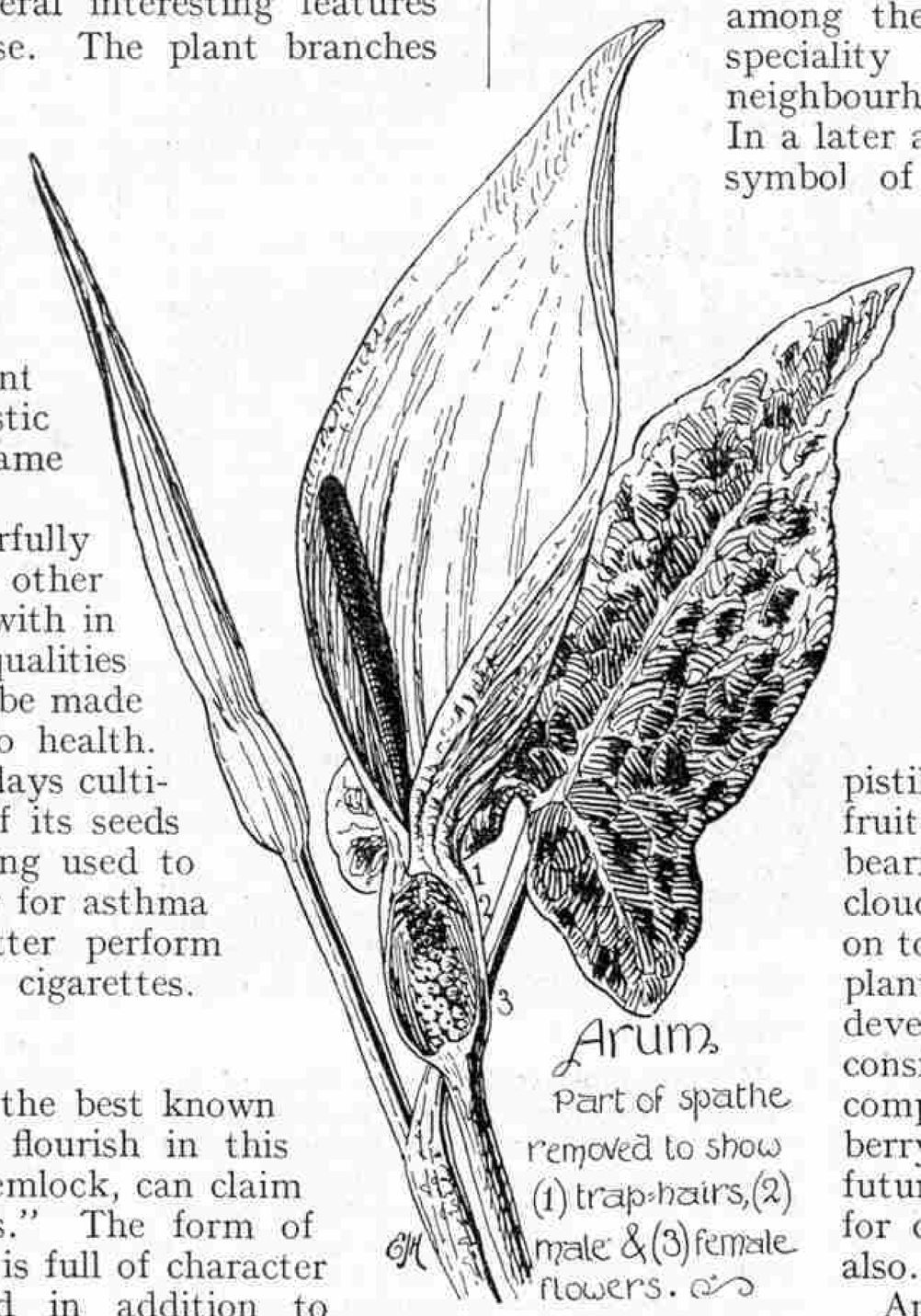
The Historic Yew

In the Yew we have one of the best known of the poisonous plants that flourish in this country and one which, like Hemlock, can claim a place among the "ancients." The form of the Yew, like that of the Oak, is full of character and impressive dignity; and in addition to possessing great historical interest, both trees—especially the Yew—are worthy exponents of longevity.

At Fountains Abbey, near Ripon, Yorkshire, for instance, there are Yew trees reputed to be well over 800 years old. As is to be expected in the case of such veterans, the centuries-old trunks attain to remarkable girth, and some historic Yews have attained a circumference of close upon 85 ft. Some indication of their long life may be calculated from the fact that toward the sixtieth year the annual increase in thickness of a Yew tree slows down permanently to roughly one-twelfth of an inch.

The antiquity of the Yew is borne out by the fact that its timber has been recovered from the ruins of one of the pre-historic palaces of Nineveh—a wonder city of Iraq countless ages ago. The wood appears originally to have been wrongly identified, for an inscription in the palace declares it to be cedar from Lebanon. The "graven images" of the heathen people of those days are thought to have been made from Yew on account of its hardness and durability. During the Middle Ages the wood became largely adopted for making bows.

The Common Yew of the British Isles seems to have attained a considerable degree of veneration among the ancient Britons, who made a speciality of planting these trees in the neighbourhood of their places of worship. In a later age the Yew became regarded as a symbol of immortality on account of its being an evergreen, and the custom developed of planting Yew trees in the churchyards. The leafy horizontal branches of the Common Yew often extend for a considerable distance. The wood has a yellow-orange tint and the leaves are long, linear and of quite a leathery texture. On the upper side they are somewhat dark coloured, but pale on the under side.



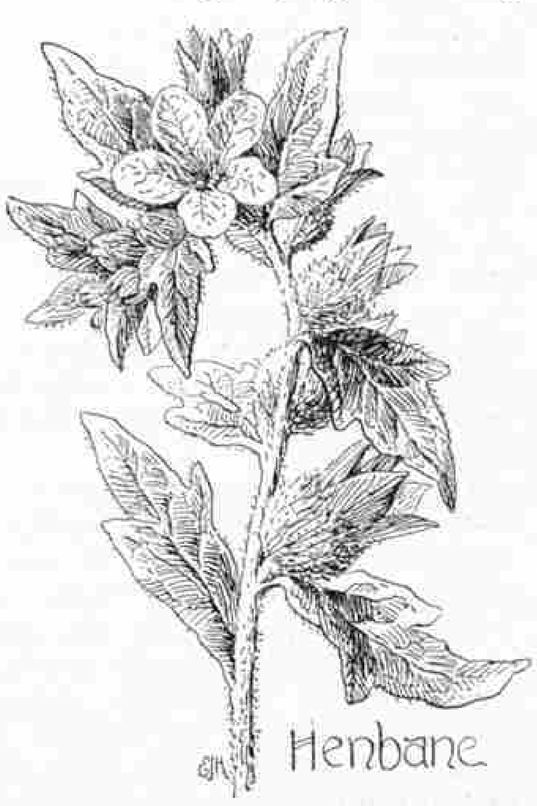
Of the male and female Yew trees only the latter bear the pistilate flowers that later produce fruit. On striking the male or stamen-bearing tree in March we may set free clouds of yellow pollen which, settling on to the pistilate flowers of the female plant, will cause the seed therein to develop. When matured the fruit consists of a soft red cup of gummy composition in which is held the hard berry that contains the seeds for future trees. The berry is poisonous for children, and to cattle the leaves also.

Another species of Yew tree is the Irish Yew which, as its name implies, is a native of Erin.

The Black and the White Bryony

The Black Bryony and the White Bryony are two of the most interesting members of our poisonous plants that belong to the climbing family. The reason they are so named is not discernible until the plants are dug up, when the former will be found to have black roots and the latter white. The plants are wholly unrelated to each other.

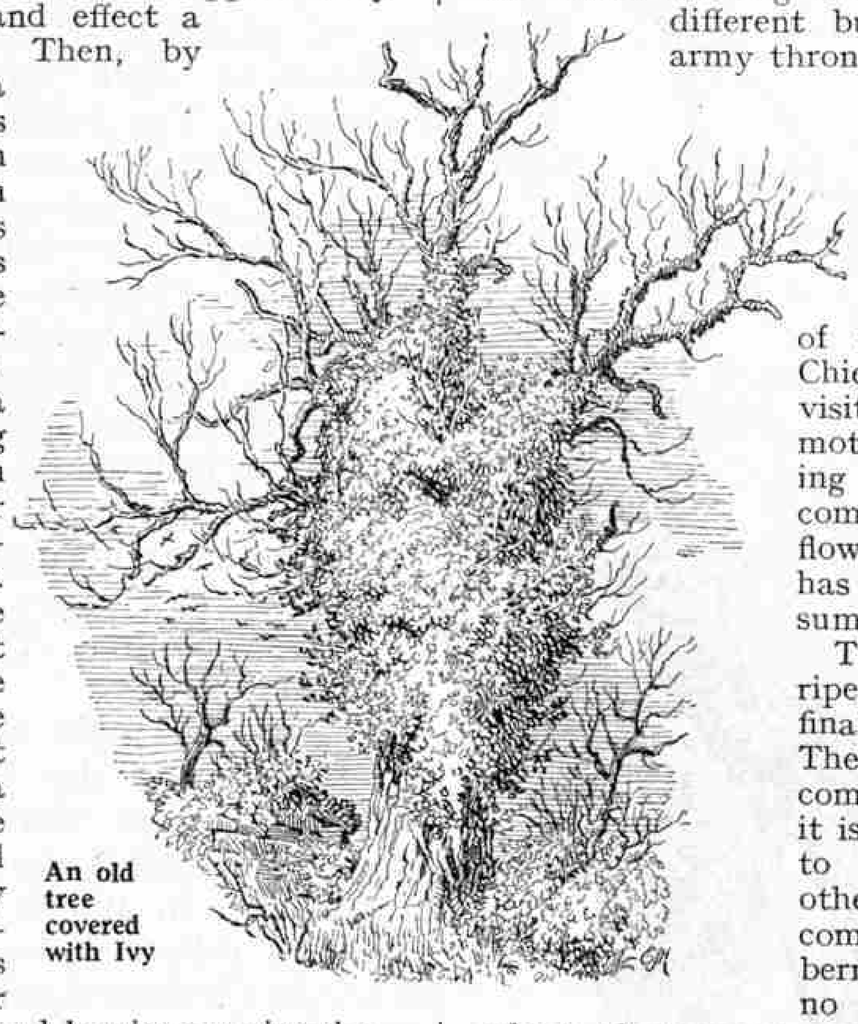
The leaves of the Black Bryony are heart-shaped and dark green, with a pleasing polished surface. Although solely a climbing plant the Black Bryony gets along quite well without the use of tendrils, and climbs by twisting its cord-like stem about convenient bushes. As in the Yew, the male and female flowers appear on separate plants. The greenish flowers are succeeded—in the case of the female—by thick clusters of elliptical berries exhibiting a range of rich colours akin to those of the fruit of the Woody Nightshade. In autumn the Black Bryony leaves show various shades of soft yellow or bronze and, together with the fruit, form excellent material for



long festoons and harvest decorations.

In contrast to the Black Bryony, the White Bryony climbs by means of beautiful spiral tendrils. These turn slowly as though cautiously feeling their way about, and on finding a suitable support they twist around it and effect a firm anchorage. Then, by successive loops, a tension spring is cleverly formed in the tendril between the plant and its support. This seemingly delicate coil, besides drawing up the plant functions as a buffer, yielding slightly to sudden strains and never snapping in ordinary circumstances.

The leaves are shaped somewhat like the palm of the hand, with the tendrils situated at their base. If a specimen of the foliage is desired for leisured study it should be gathered fairly early, as the leaves wither away while the round berries are ripening. The cucumber, the melon and the gourd are all related to the White Bryony, although not sharing its poisonous qualities.



An old tree covered with Ivy

The Unique Ivy

Probably the best-known of all our climbing plants is the Ivy. This venerable plant was well known to the ancient Greeks and Romans, among whom it held an honourable place. To-day it is known and valued in all parts of the world.

The beauty and charm that Ivy can bestow upon an old building are evidenced in the many historic abbey and castle ruins in this country to-day. Ugly, partly demolished abutments; windowless apertures; broken columns; fragments of crumbling walls—all are gently rid of their gauntness and gaping wounds by the abundant Ivy spreading over them a green coverlet. New buildings as well as old are often greatly improved pictorially by a front of neatly trimmed Ivy. Although more than 50 species of Ivy have been identified, they may be roughly classed as of three types—the European Ivy, the African Ivy and the Asiatic Ivy, and of these the first is, of course, the best known in this country.

Ivy is interestingly original in its conduct and provides an exception to several usual rules in Nature. Towards the end of September we may begin to look, not for the fruit, but for the green flower clusters, which contain much fully exposed nectar and seem intended as a special provision of Nature for insects at a time when other food supplies are fast diminishing.

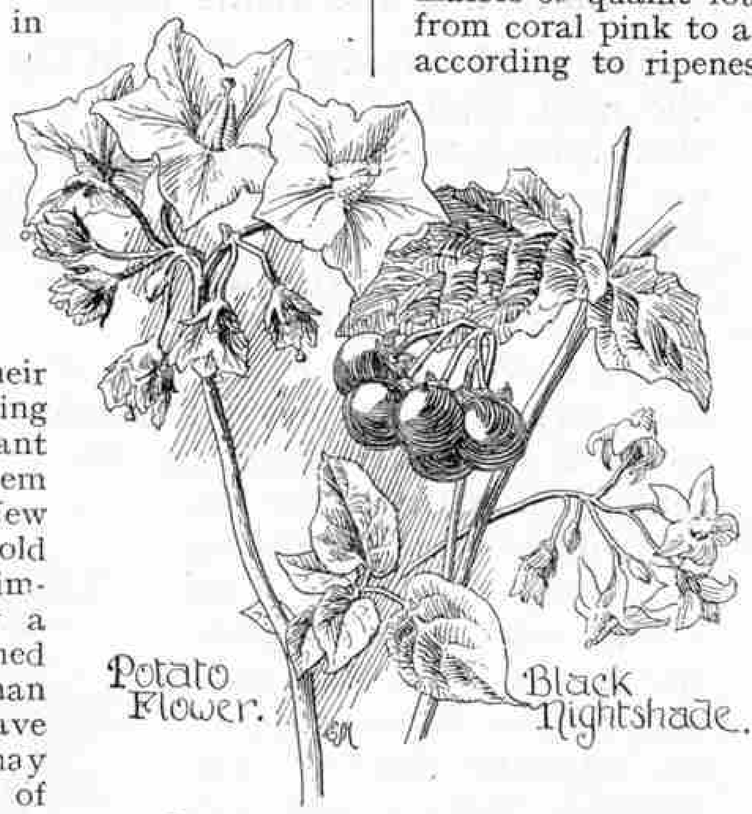
An inspection of any of these flower clusters will reveal how tremendously popular they are with the insect world. Flies, bluebottles, wasps and sometimes butterflies will be found crowding over the sweet-smelling flowers. At night a different but equally hungry army throngs to the feast and the light from a lamp thrown upon an old wall or a tree bole well covered with ivy is almost certain to disclose a scene of nocturnal activity. Chief among the night visitors to the Ivy are moths. It is interesting to note that the common Ivy does not flower at all until it has climbed to the summit of its support.

The five-celled berries ripen in winter, their final colour being black. The fruit is very welcome to the birds for it is rendered available to them just when other berries are becoming scarce. Ivy berries, however, are no friend of man, to whom they cause acute illness if eaten.

Spindle Tree

Mention must certainly be made of the Spindle Tree, a shrub that is often to be seen in our woodlands and hedgerows and beautifying large suburban gardens. From the greenish-coloured, four-petalled flowers that it produces in May, the Spindle Tree progresses toward fruition in the autumn, when it presents a very striking appearance.

The branches then are decked with reddened lance-head-shaped leaves and masses of quaint four-lobed fruit, varying from coral pink to a beautiful rose colour, according to ripeness. It is easy to see why the Spindle Tree is popularly called "the burning bush"! Each lobe contains a poisonous seed wrapped in a bright, orange-coloured coat. When the fruit is fully ripe, the envelopes, or lobes, burst and the berries are liberated. The bright fruit has ended the career of more than one unsuspecting sheep that has consumed it, and the berries are harmful generally.



An excellent yellow dye may be obtained from the orange-coloured coating of the seeds, while in Germany the shoots come in very handy, after they have first been bored through, for pipe stems! The wood is very compact and is extensively used for making butchers' skewers. The name "Spindle Tree" is derived from its former use in making spindles for weaving.

Laburnum

We must not omit the Laburnum, for there are indeed few sights more beautiful than this plant in all its Maytime glory of graceful leafy branches, drooping with hundreds of delicate golden flower pendants. In the gardens of villas, in spacious parks or in the country the Laburnum's wealth of colour makes it at once an arresting sight, and it is small wonder that the plant has become so universally popular. The blossom appears in April and May and grows in the form of drooping clusters of yellow flowers, each calyx having two short obtuse lips.

The pea-shaped blossoms proclaim the Laburnum to be of the bean order and, as a matter of fact, it is a big relative of the little clover. Note the pretty triple leaves. The fruit is in the form of a long pod and, if eaten, the seeds contained therein immediately bring on an attack of dizziness and fainting.

From this short review it will have been seen that many of our poisonous plants are not only harmless in appearance but also very beautiful and attractive. In dealing with plants of any kind therefore the only safe rule is never to taste any part of them unless one knows definitely that it is harmless.

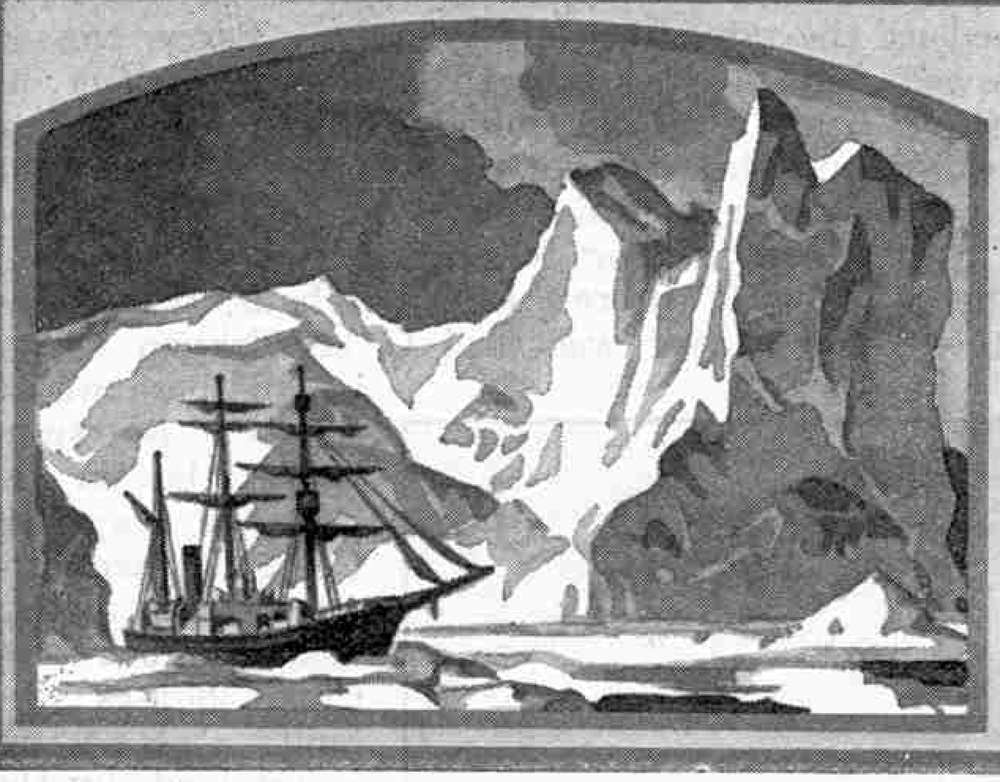
New Aerial Fire Fighters

Plans have been completed for a new sky-scraper in New York, to be known as the Larkin building, that will tower to a height of 1,208 ft. or nearly a quarter of a mile! In Detroit an 80 storey building is to be erected that will be 100 ft. taller than the famous Woolworth building, and similar erections are projected in other parts of the United States. These huge buildings are practically streets running up into the air instead of along the ground, and they give rise to many new problems.

One of these problems is how to get water to a fire occurring in the upper stories of these buildings. A big fire in a building that accommodates such a huge crowd of people would almost certainly have disastrous results, and while every preventive device is made use of, it is still necessary to devise suitable fire-fighting machinery. Engine-driven pumps would have to produce a terrific pressure to force the water so high up, and an equally serious difficulty would be presented by the weight of the water-filled fire hose necessary.

In regard to the latter point, E. P. Conlin, of Ohio, has suggested an ingenious apparatus whereby the pressure of the water itself is made to carry the hose to the required height. The water pumped up the central tube of the apparatus, to which the hose is attached, operates a water wheel that is connected by worm gearing to two horizontal propellers above the apparatus. These propellers lift the machine to a height dependent on the pressure of the water supply. The stream of water to be directed upon the fire issues from a nozzle at one end of the apparatus, and a third propeller at the other end is geared to run at a speed sufficient to neutralise the recoil of the machine.

The idea is extremely ingenious. At maximum height the pressure of the water delivered would not be very great, but it would be delivered in quantities from above the fire, so that the burning floors would be completely drenched. Guidance of the machine presents another difficulty, but it is suggested that the manipulation of the hose pipe from the ground would suffice to direct the water to the spot where it is wanted.



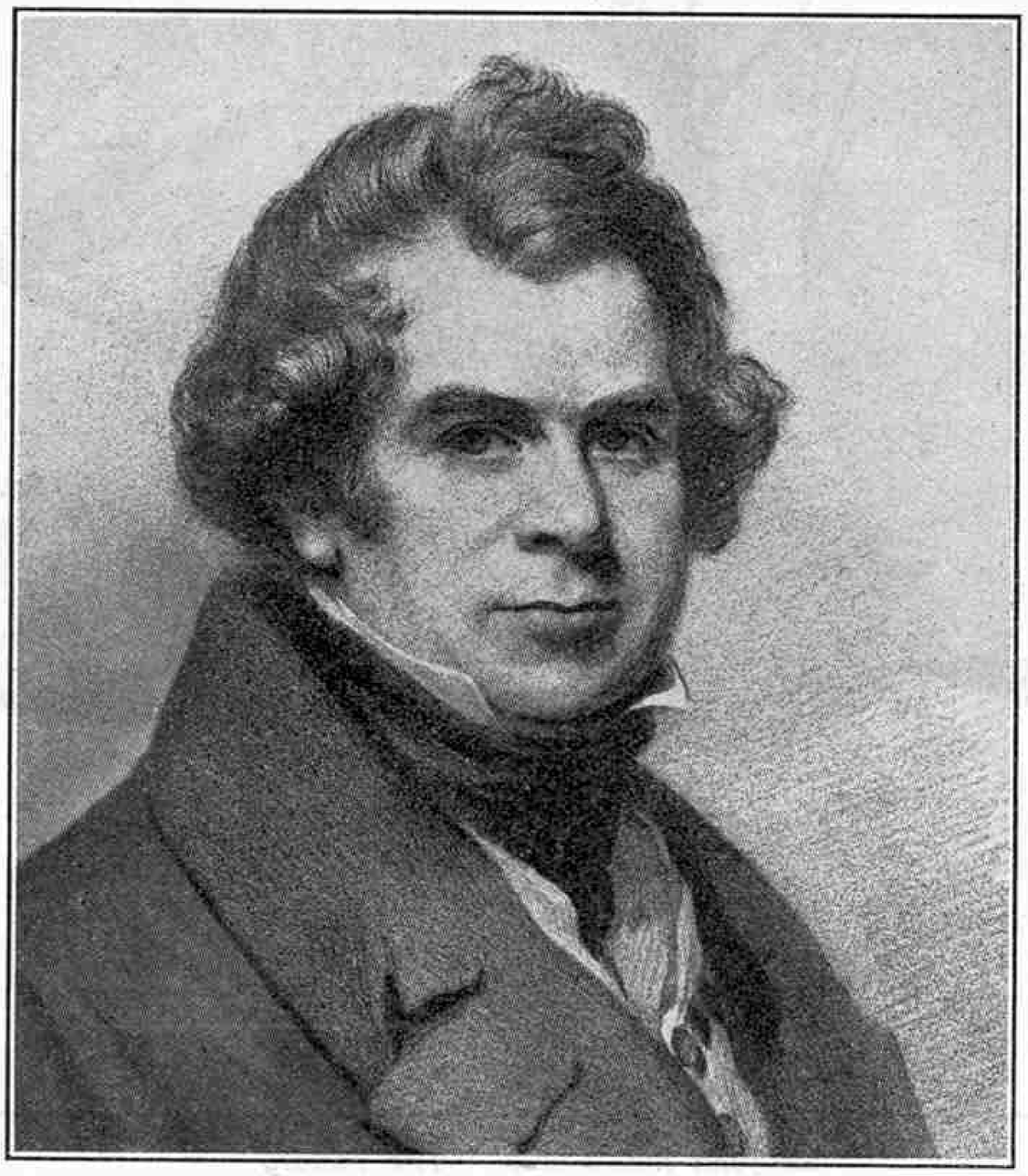
EXPLORING THE ARCTIC

Famous Explorers and their Attempts to Reach the Pole.

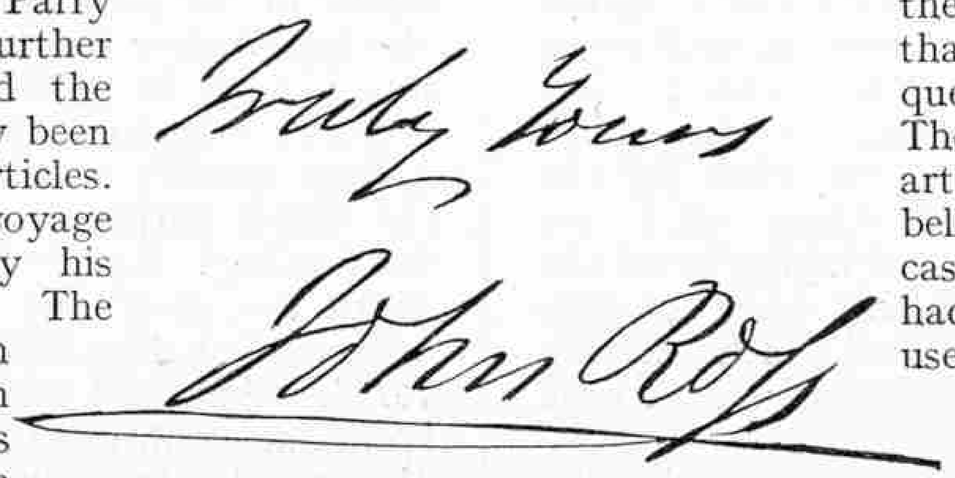
VIII.—SIR JOHN ROSS TAKES THE FIRST STEAM ENGINE INTO THE ARCTIC

JOHN ROSS, the fourth son of the Rev. Andrew Ross, minister of Insch in Wigtonshire, was born in 1777 at Insch and entered the Navy in 1786. As was the case with Parry, with whom we dealt last month, Ross began life as a first-class volunteer on board a man-of-war.

In 1818 he was appointed by the Admiralty to command an expedition to the Arctic for the discovery of the northwest passage, and he had Parry with him as his lieutenant. Ross proceeded a considerable distance up Lancaster Sound and came to the conclusion that the Sound terminated in a chain of mountains some distance ahead. He named this range "Croker's Mountains" and even included an illustration of them as a full page plate in his book. We mentioned this incident in a former instalment, and the fact that Parry, who accompanied Ross, saw no mountains and told Sir John Barrow so when he saw him at the Admiralty.



Captain John Ross, R.N., and (below) his Signature



Ross returned to England without having accomplished the main object of his expedition—the discovery of a northwest passage—and Parry was subsequently sent on a further expedition in the "*Hecla*" and the "*Griper*," in 1819, as has already been described in this series of articles.

In 1829 Ross made a further voyage to the Arctic, accompanied by his nephew James Clarke Ross. The latter had previously made an Arctic voyage as a lieutenant in charge of one of the sledge boats in Parry's dash for the Pole, which was described last month. With the exception of some £2,000, which was added by Ross himself, the expenses of the 1829 expedition, amounting to over £17,000, were paid by Sir Felix Booth, a wealthy distiller and a friend of John Ross.

The expedition was made in the "*Victory*," a vessel that is of particular interest to us because it was the first ship fitted with a steam-engine to be used in Arctic exploration. She was an old Isle-of-Man packet-boat of 85 tons, which Ross increased to 150 tons by raising her sides 5 ft. He also took out her old fixed paddle-wheels and replaced them with a pair of patent paddles that could be hoisted out of the water at a moment's notice, so as to clear any ice that might be encountered.

It is interesting to learn that the engine was made by Braithwaite & Ericsson, the builders of the "*Novelty*"—the locomotive that made such a wretched performance in the famous contest at Rainhill, in which George Stephenson's "*Rocket*" triumphed. The feature of the engine of the "*Victory*" was that no flue was required and consequently a funnel was unnecessary. The fires were kept burning by an artificial draught provided by two bellows of unequal sizes, as in the case of the "bellows draught" that had failed so conspicuously when used on the "*Novelty*."

With this contraption Ross, who all will agree was at least an enterprising man, ventured

into the Arctic. Naturally he soon encountered trouble and the "execrable machinery," as he called it, "came adrift before the ship reached Woolwich and the expedition was delayed until it was repaired." At Woolwich a number of distinguished men—including Sir Byam Martin, Comptroller of the Navy, Sir John Franklin, and the Duke of Orleans—went on board and said uncomplimentary things about the engine.

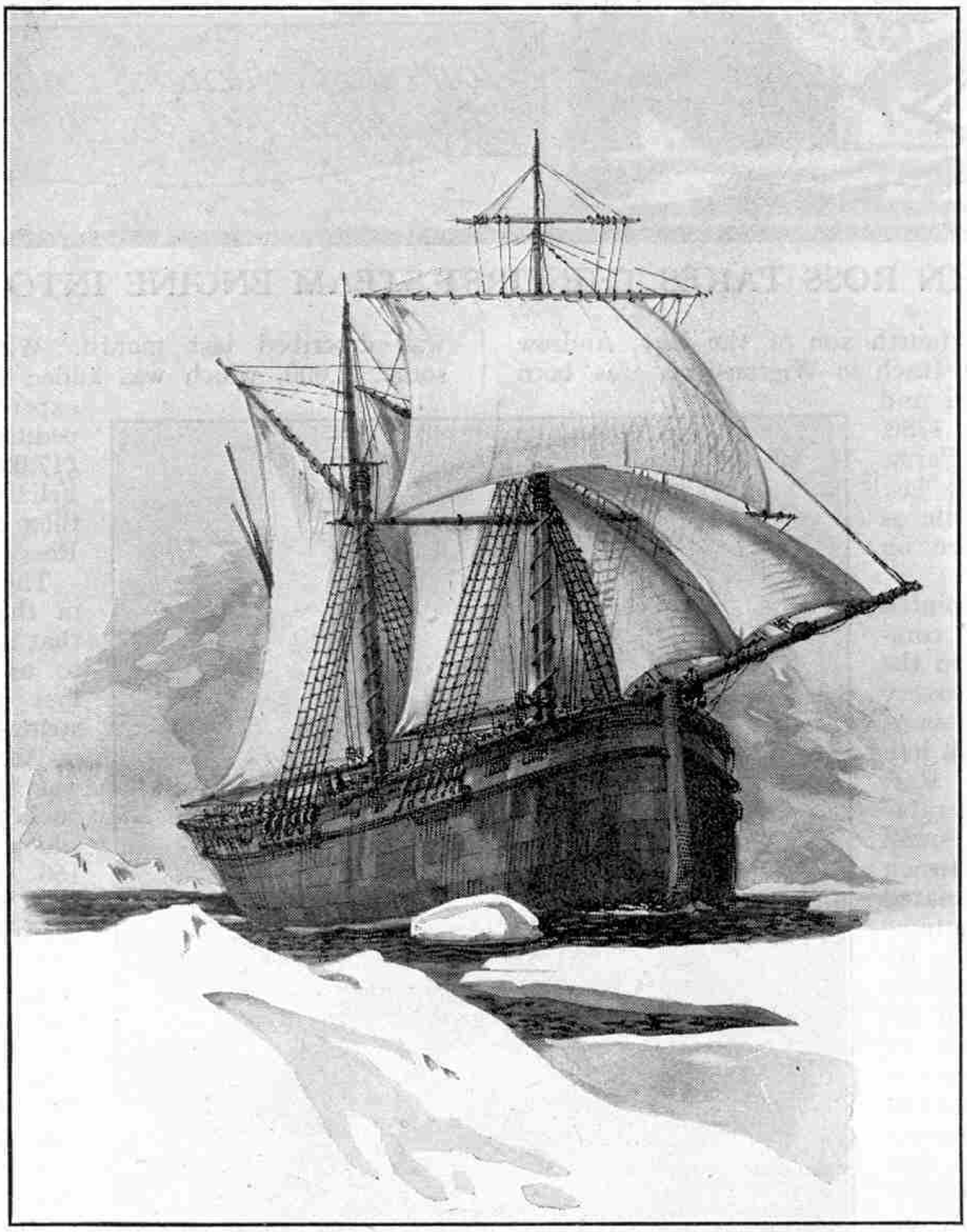
Repairs having been effected, the engine (and the sails) took the "*Victory*" to Margate in twelve hours. Here the boiler was leaking so much that the additional hand forcing-pump had to be kept going all the time. When off Land's End it was found that the piston rod had been rubbing against the guide wheels and a piece of iron had to be brazed on to strengthen it!

And so the story goes on all the way to the Arctic—the keys on the main shaft broke and were replaced by wooden ones, which broke one after another. "The boilers continued to leak," says Ross, "though we had put dung and potatoes in them by Mr. Ericsson's directions." The air-pump drew quantities of water. The feed pump drew air and would not supply sufficient water to the boiler. Both pairs of bellows wore out. Off Fallaway a stoker fell into the machinery and had his arm nearly severed above the elbow. Next, the teeth of the fly wheel sheared; the boiler joints gave way, and the water, or rather potato soup, flowed out and put out the fire! So things went on until every part of the engine had given way at least once!

When, later, the "*Victory*" laid up for the winter frozen in the ice, we can imagine with what joy the crew occupied their spare time in taking what was left of the engine out of the ship and laying it on the ice, and it is not surprising to learn that when the ship resumed her voyage it was left there! Such was the ignominious introduction of the steam engine to Arctic exploration.

Ross sighted Sanderson's Hope, sailed through Lancaster sound and reached Fury Beach. Here he picked up the provisions left behind by Parry, crossed Cresswell Bay and discovered new land, which he named Boothia after the founder of the expedition. He sailed into the entrance to Bellot Strait, where he was on the verge of realising the dream of centuries—the discovery of the north-west passage.

The "*Victory*" entered Felix Harbour, where she wintered, and a visit was paid to an Eskimo village where there was a number of snow houses that in appearance suggested basins turned upside-down. Ross has described how these houses are built. "Having ascertained, by the rod used in examining seal holes, whether the snow is sufficiently deep and solid," he tells us, "the natives level the intended spot by a wooden shovel, leaving beneath a solid mass of snow not less than three feet thick. Commencing then in the centre of the intended circle, which is ten feet or more in diameter, different wedge-shaped blocks are cut out, about 2 ft. long, and a foot thick at the outer part; then trimming them accurately by the knife, they proceed upwards until the courses, gradually inclining inwards, terminate in a perfect dome. The door being cut out from the inside before it is quite closed, serves to supply the upper materials. In the meantime the women are employed in stuffing the joints with snow, and the boys in constructing kennels for the dogs. The laying of the snow sofa with skins and the insertion of the ice window complete the work; the passage only remaining to be added, as it is after the house is finished, together with some smaller huts for stores."



Sir John Ross's Ship, "*The Victory*"

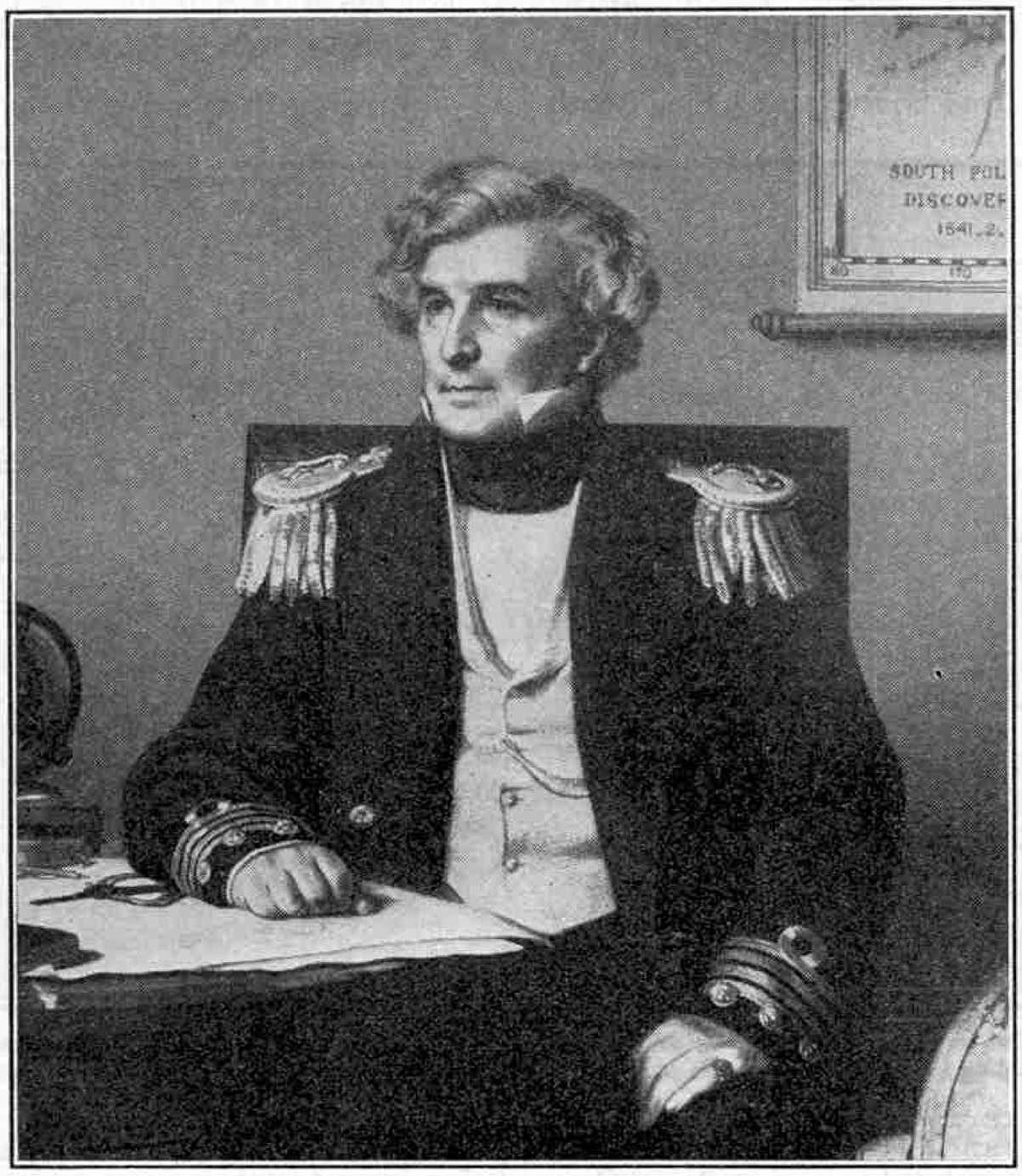
Ross quickly made friends with the Eskimos after the ship's carpenter had fitted one of them with a wooden leg! He obtained much information from them as to the geography of the surrounding district and one of them, Ikmallik, drew a map of the coast line in Ross's cabin, and much of the subsequent voyage was spent in confirming the information thus obtained. More new land was discovered and named King William's Land.

The "*Victory*" spent four winters in the Arctic being frozen in Felix Harbour on the west side of the Gulf of Boothia in 1830 and again in the following year. In 1832 the ship, having been frozen in for the third time, was abandoned, and Ross and his men, taking to the boats, proceeded to a place where a vessel had been abandoned in 1825. They found that this abandoned ship contained a store of provisions and having repaired the boats they made their way to Leopold's Island, passing the following winter at Fury Beach. In August 1833 Ross and his men were picked up by the "*Isabella*," his old ship, off Lancaster Sound, and they reached the Humber in October much to the relief of those at home who had given up the expedition for lost.

As we shall shortly learn Sir John Franklin became lost in the Arctic regions and Ross's third and last expedition was undertaken in 1850 in the attempt to ascertain the fate of the missing explorer. He returned without gaining any information and having accomplished nothing.

Shortly after his return in 1833 Ross had been knighted, made C.B. and elected a member of many learned societies. He was raised to the rank of Admiral in 1851 and died in London on the 31st August 1856.

It may here be mentioned that in 1847 Ross's work was linked up with Parry's explorations at the mouth of the Fury and Hecla Straits, by John Rae, in the employ of Hudson Bay Company. Rae showed that the land discovered by Ross, which he had named Boothia, was really part of North America.



Rear-Admiral Sir James Clark Ross

James Clark Ross, the Captain's nephew, who was mentioned earlier in this article, discovered (on 1st June 1831) the position of the north magnetic pole on the west coast of Boothia. To quote his own words :—

"The land at this place is very low near the coast, but it rises into ridges of fifty or sixty feet high about a mile inland. We could have wished that a place so important had possessed more of mark or note. It was scarcely censurable to regret that there was not a mountain to indicate a spot to which so much interest must ever be attached ; and I could even have pardoned any one among us who had been so romantic or absurd as to expect that the magnetic pole was an object as conspicuous and mysterious as the fabled mountain of Sinbad, that it even was a mountain of iron, or a magnet as large as Mont Blanc.

"But Nature had here erected no monument to denote the spot which she had chosen as the centre of one of her great and dark powers ; and where we could do little ourselves towards this end, it was our business to submit, and to be content in noting by mathematical numbers and signs, as with things of far more importance in the terrestrial system, what we could but ill distinguish in any other manner. . . . . .

"We fixed the British flag on the spot and took possession of the North Magnetic Pole and its adjoining territory in the name of Great Britain and King William the Fourth. We had abundance of materials for building, in the fragments of limestone that covered the beach ; and we therefore erected a cairn of some magnitude, under which we buried a canister containing a record of the interesting fact ; only regretting that we had not the means of constructing a pyramid of more importance and of strength sufficient to withstand the assaults of time and of the Eskimos. Had it been a pyramid as large as that of Cheops I am not quite sure that it would have done more than satisfy our ambition, under the feelings of that exciting day. The latitude of this spot is 70° 5′ 17″, and its longitude 96° 46′ 45″ west."

James Clark Ross was born in London on the 15th April 1800 and entered the Navy in 1812. From 1819 to 1825 and again in 1827 he was engaged with Captain Parry in his Arctic voyages and served under his uncle Sir John Ross from 1829 to 1833. His greatest achievement was the discovery of the position of the North Magnetic Pole. He commanded the expedition in the "*Erebus*" and "*Terror*" to the Antarctic in 1839 and was there for four years. It was on his return in 1844 that he was knighted. He made his last expedition in 1848 in the "*Enterprise*," when he searched Baffin's Bay for the survivors of the Franklin expedition. He died at Aylesbury on the 3rd April 1862.

"Down a Tin Mine"—*(continued from page 322)*

When we reached the top, we saw the ore being crushed into small pieces. We then went to the mill about a mile and a half away. There the ore is first crushed to powder and afterwards washed a great many times on a kind of table that is continually shaking, thus imitating the vanning shovel. The ore is grey at first on account of the arsenic in it, but is passed through a furnace in which the arsenic goes off as a gas and is caught in the flues and condensed. They produce enough arsenic in a year to kill all the people in the world !

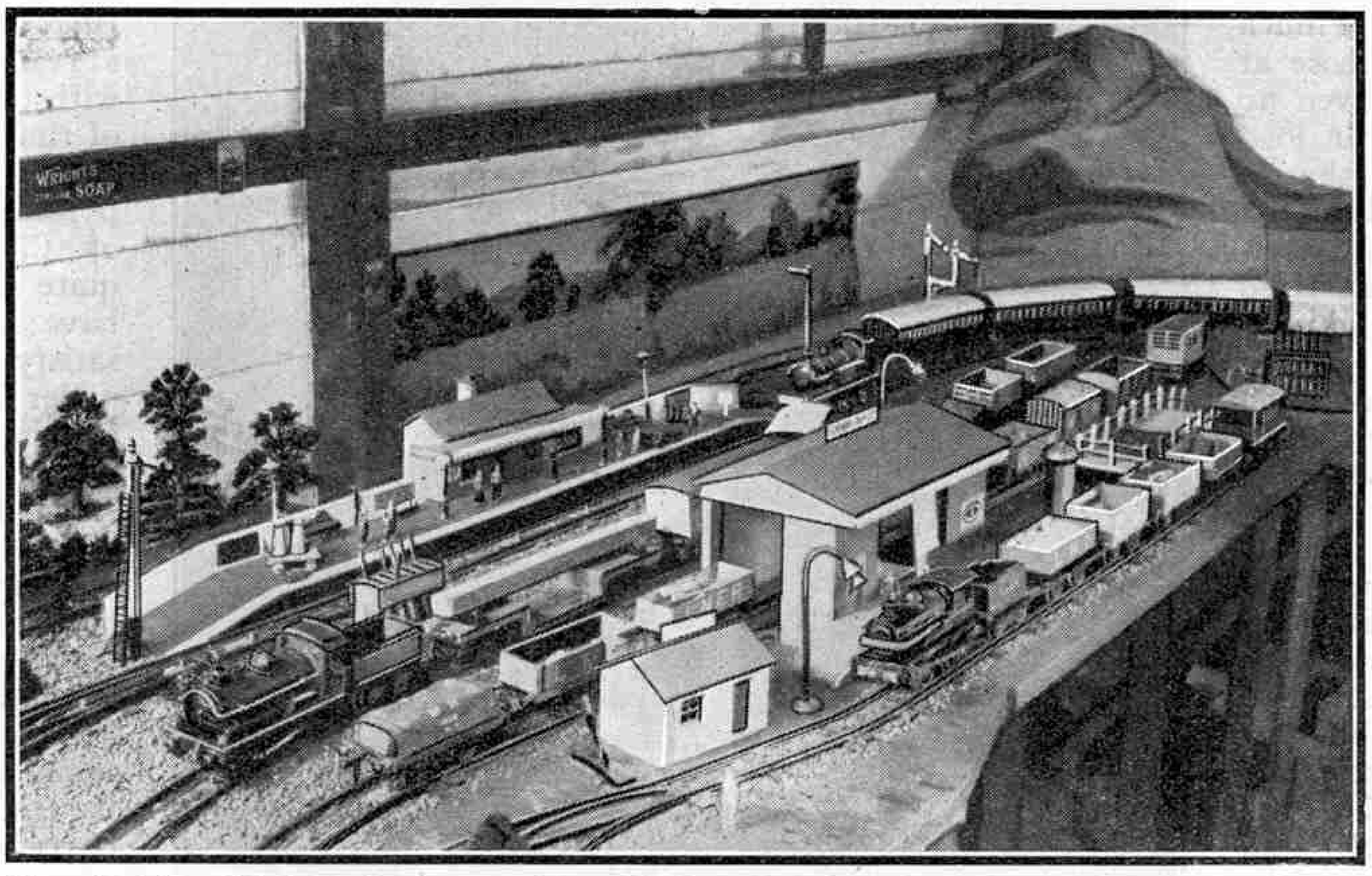
Finally the ore is washed again and the resulting powder, now red in colour—freed from arsenic—and containing about 63 per cent. of tin, is sent to the smelters.

J. LEVISON (Bayswater, W.2).

Running a Miniature Railway

How to Get More Fun Out of Your Train System

ENTHUSIASM for model railway working in most cases does not develop suddenly but grows slowly but surely from very small beginnings. The first stage generally consists of the operation of a circular or oval layout such as is contained in a small set bought complete. Such a layout affords keen enjoyment for a while, but sooner or later its limitations make themselves felt and its owner realises that it bears very slight resemblance to the real thing. This point is usually the beginning of the model railwayman's career. The mere running round and round of a locomotive hauling a train of carriages or trucks becomes monotonous and wearisome, and his mind becomes filled with a great ambition—that of developing a railway that shall be in every sense a real miniature of its full-sized prototype.



The main station of the interesting 0-gauge railway of Mr. C. F. Rhys, Salisbury. This railway is an excellent example of what may be accomplished in this gauge in regard to both railway realism and picturesque appearance

The first problem that faces the model railway owner is that of designing his layout. The majority of layouts may be divided into two classes, continuous and non-continuous, and of these non-continuous layouts are most suitable for clockwork engines.

Before deciding upon any definite scheme it is an excellent plan to imagine that one is about to build a railway for some definite part of the country, which may be agricultural, manufacturing or mining in character, with perhaps a seaport at one end of the line. As far as possible the rolling stock should be suitable for the type of country selected, open wagons being most numerous in a mining district and covered wagons in a manufacturing district with, of course, a fair proportion of open trucks.

Generally speaking it is advisable to have the two terminal stations adjacent so that when necessary one operater can work both. The position of wayside stations does not matter so much as they can be cut out altogether if the operator working the line finds it too big a task to handle them.

A Simple Station Layout

Judging from our correspondence the owners of model railways find their greatest trouble in arranging their stations on workmanlike lines. In this connection the first point to bear in mind is that a miniature station layout must be free from complications, otherwise it becomes unworkable. Fig. 1 shows a useful arrangement for a single platform on the main line with goods sidings connected to the main line by a crossover. In making up a goods train at a terminal station it is advisable to arrange for the wagons intended for this station to be placed next to the engine, in order to reduce shunting operations as much as possible. In the case of an "up" goods train, the train should be stopped at signal 1 to uncouple the front part. After lowering the signal the engine and wagons should be run forward as far as signal 2 which must be at "danger." Then the points are altered, signal 3 is lowered and the vehicles are shunted back into siding A, where the engine is released. After returning signal 3 to "danger" number 5 is lowered and the engine is run out on to the main line as far as signal 2. Signal 5 may then be placed at "danger," the points re-set for the main line, and the engine backed on to its train. If there are wagons to be taken away from this station these should be shunted out first, leaving them coupled to the engine while the arriving wagons are shunted in.

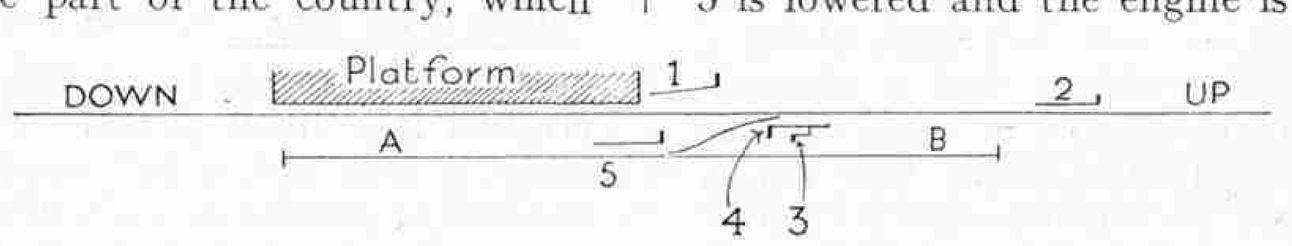


Fig. 1
Signals :—1. Up Main Line ; 2, Up Main Starting ; 3, Down Goods Home ; 4, Down Main Home ; 5, Goods to Main Line

For a "down" goods train, after uncoupling the engine at signal 3, the points should be altered, the signal lowered and the engine alone run into siding A. The points are then re-set, the engine is backed on to the

departing trucks and draws them out to siding A. When the points have again been set for the siding and signal 5 lowered, the wagons should be carefully backed on to the train on the main line and coupled up. Trucks that are to be left at the station should then be shunted into siding B in a similar manner.

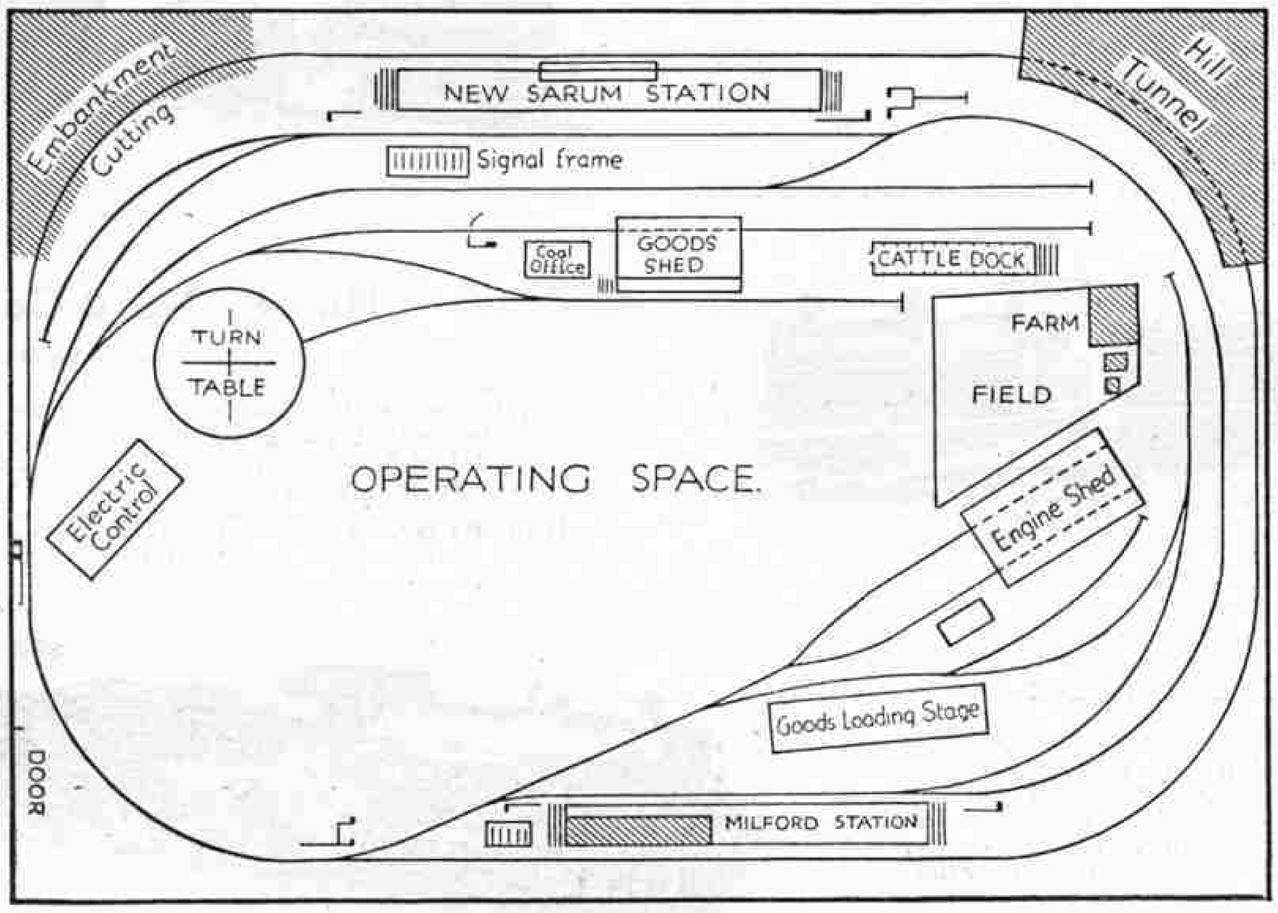
More Elaborate Working

Fig. 2 shows a passenger train passing station having one platform for each direction and a goods yard on the "up" side. As each line is used only by trains running in one direction, junction signals are not necessary, signals 1 and 3 being lowered when the points are set for the left-hand direction.

In order to shunt wagons from a "down" goods train, a fairly complicated operation is necessary, but this can be avoided by having another goods siding as shown by the dotted lines. If this is not provided the train should be run through the "down" platform stopping with the last truck just beyond signal 3. Then the points for the "up" line should be altered, signal 3 lowered, and the train backed into the platform line. If the down line is clear the engine should then draw out to signal 3 and run back over the "down" line to signal 1. The points should be set for the "up" platform and the engine shunted back so that it will push its train into the goods yard for which the points already should be set.

When the first batch of wagons has been detached the engine draws the remainder back into the platform and then runs round the train via the "down" platform road. After arriving at signal 3 the engine is backed to its train which is then ready to leave.

The foregoing movements may appear to be difficult, but in actual practice the operations involved are fairly simple provided that the principles indicated are followed. "Up" goods trains back direct into the yard from the "up" platform and need not obstruct the "down" line.



Complete plan of Mr. Rhys's Model Railway (see illustration on previous page)

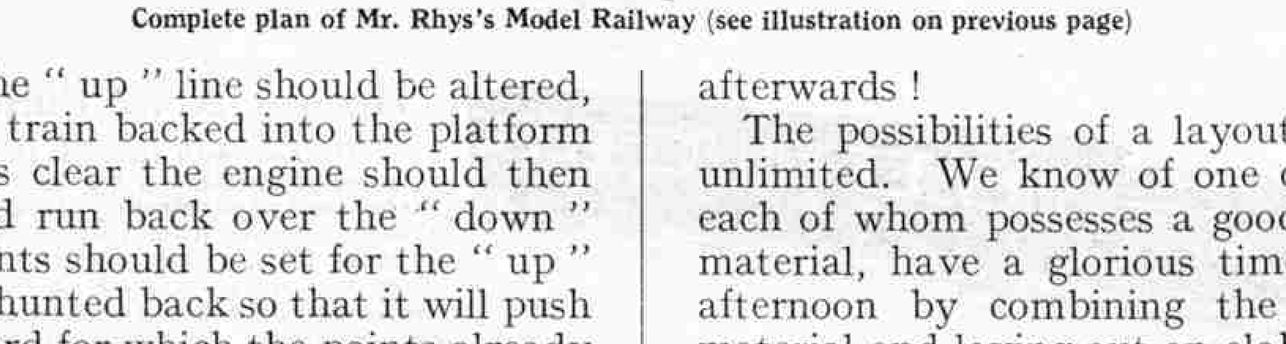


Fig. 2

Signals : 1, Down Main Home ; 2, Down Main Starting ; 3, Up Main Home ; 4, Up Main Starting ; 5, Shunt, Up Platform to Goods Yard

It is impossible to lay down any hard and fast rules in regard to the accessories for a model layout but in order to give a fair amount of realism to the general appearance certain items may be considered as more or less essential. Goods yards, for instance, require loading gauges at their exits and in a large yard lamps may be placed between the sidings as would be the case in actual practice. A locomotive yard should have at least one water tank, and a turntable is necessary when tender engines are employed. One turntable may replace several points in a large engine depôt, thus saving both expense and space. Such accessories as level crossings, telegraph posts, foot bridges, etc., may be added from time to time when circumstances allow, and thus the smallest system if properly designed may be continually extended and improved, being "always complete but never finished."

Making the Most of Things

It frequently happens that, owing to the limited floor space available in a small room, particularly one containing a good deal of furniture, a satisfactory layout is difficult to arrange. In many even quite small houses, however, there is often a fairly long hall or landing that can be pressed into service, thus making possible a much longer run than could be obtained in any of the rooms. In the case of a landing it is often possible to arrange the layout so that the line passes into and round a bedroom, and it is quite exciting to watch the trains disappear into the room and come into view again in business-like fashion shortly afterwards !

The possibilities of a layout of this kind are almost unlimited. We know of one case in which three boys, each of whom possesses a good supply of Hornby train material, have a glorious time almost every Saturday afternoon by combining the whole of their railway material and laying out an elaborate track on a landing.

We frequently receive queries regarding the use of Hornby track out of doors. Generally speaking we do not advise outdoor operations, because the Hornby rails are designed for indoor use and therefore cannot be expected to withstand outdoor conditions. At the same time, if a small level piece of close-cropped grass is available, or a level stretch of path, outdoor operations on a dry and warm summer day may be perfectly successful. Unless the conditions are particularly favourable, however, it will be found necessary to provide a foundation of planks of some kind in order that the track may be sufficiently firm and level to allow of safe running. In any case the track should not be left out all night. What has just been said of course applies to this country and other countries with a similar climate. In many parts of the world it should be possible to leave an outdoor Hornby track down for quite a long period without any harm resulting. If a permanent outdoor railway is desired the track should be of some non-rusting material, such as brass, as described in the article on "*The Windyridge Railway*" on page 348 of this issue.

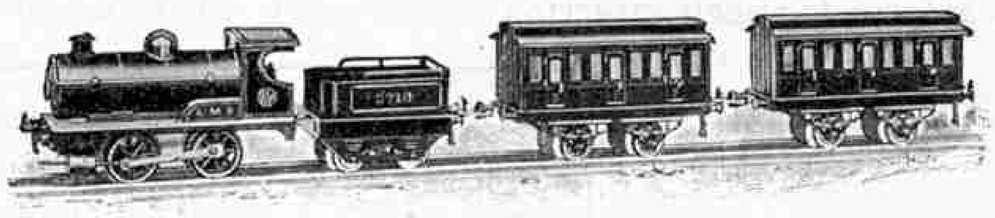
HORNBY CLOCK WORK TRAINS

BRITISH AND GUARANTEED

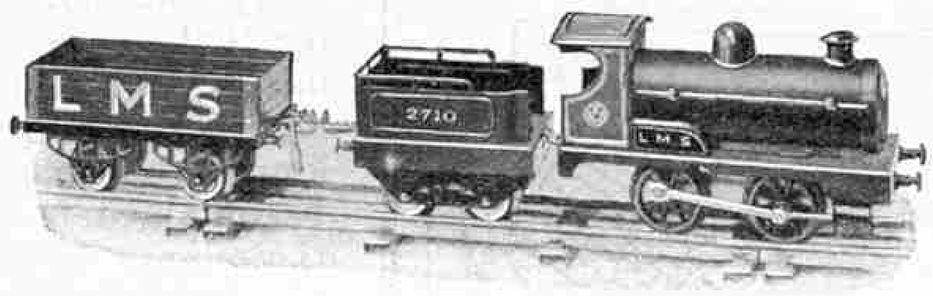
Hornby No. 1 Passenger Set

The set comprises Loco, Tender, two Passenger Coaches, and Rails to form a circle 2 ft. in diameter (including one Brake Rail, by means of which the train may be stopped from the track) and two Straight Rails. The Loco is equipped with reversing gear, brake and governor; the doors of the coaches open. In colours to represent L.M.S., G.W. or L.N.E.R. Companies' rolling stock. Gauge 0. Price, complete in strong box, **27/6.**

HORNBY No. 1 GOODS SET. This set is similar to the No. 1 Passenger Train but contains one Wagon in place of Passenger Coaches. Price, complete in strong box, **21/–.**



No. 1 Passenger Train



No. 0 Goods Train

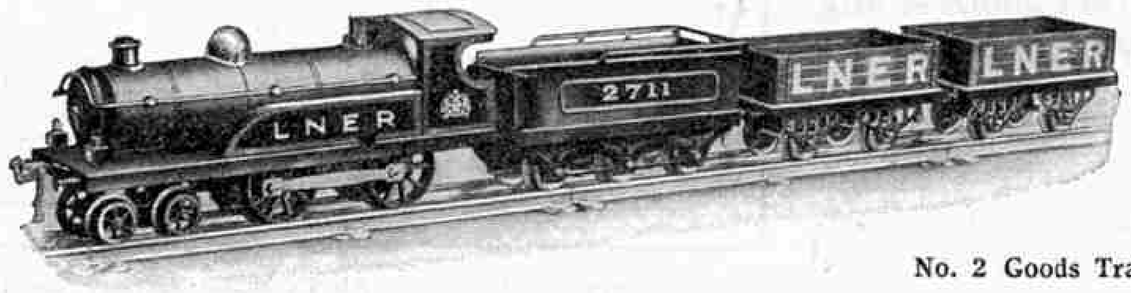
Hornby No. 0 Goods Set

Each set contains Loco, Tender, and one Wagon, with Curved Rails to form a circle 2 ft. in diameter and two Straight Rails. One of the Curved Rails carries a brake, by means of which the train may be stopped from the track. The Loco is fitted with brake and governor; non-reversing. Gauge 0, in colours to represent L.M.S., G.W. or L.N.E.R. Companies' rolling stock. Price, complete in strong box, **17/6.**

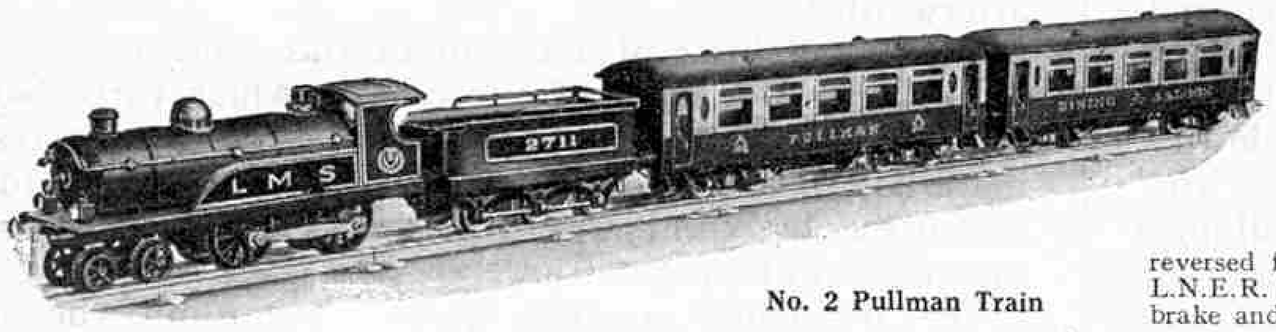
HORNBY No. 0 PASSENGER SET. This set is similar to the No. 0 Goods Train but contains two Passenger Coaches in place of the Wagon. Price, complete in strong box, **24/–.**

Hornby No. 2 Goods Set

The Loco, Tender and Rails of this set are similar to those in the No. 2 Pullman, but two Wagons take the place of the coaches. As in all other No. 2 Hornby Trains, the Loco may be both braked or reversed from the track. The Loco and Tender are enamelled in black only, and lettered L.M.S., G.W. or L.N.E.R. Gauge 0. Price, complete in strong box, **37/6.**



No. 2 Goods Train



No. 2 Pullman Train

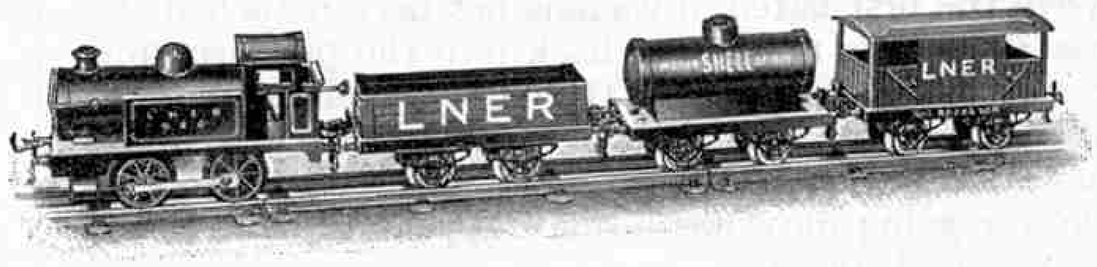
Hornby No. 2 Pullman Set

The Loco with Tender in this set measures 17 in. in length. A superior mechanism has been adopted, making it the most attractive and satisfactory clockwork train yet produced. The Coaches are beautiful both in colour and finish. Each Set includes Loco, Tender, and two Pullman Coaches, with Set of Rails to form a circle 4 ft. in diameter. The rails include one Brake Rail by means of which the train may be both braked and reversed from the track. In colours to represent the L.M.S., G.W. or L.N.E.R. Companies' rolling stock. The Loco is fitted with reversing gear, brake and governor. Gauge 0. Price, complete in strong box, **60/–.**

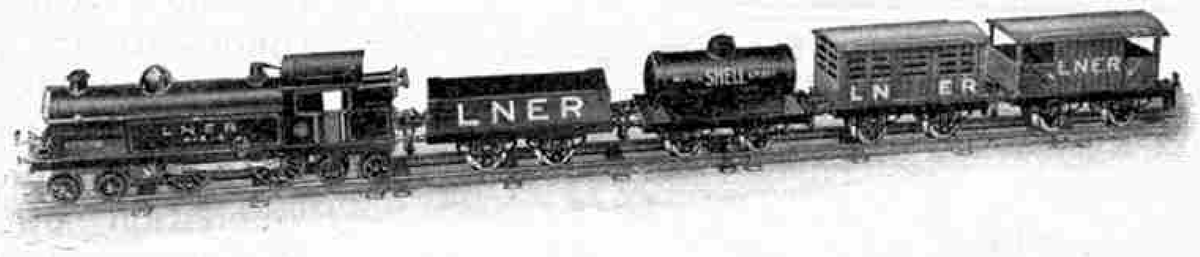
Hornby No. 1 Tank Goods Set

This set contains a No. 1 Hornby Tank Loco, Hornby Wagon, Petrol Tank Wagon, Brake Van and set of Rails to form a circle 2 ft. in diameter, and two Straight Rails. The Loco is fitted with brake, which may be operated by a lever in the cab or from the track, reversing gear and governor. Gauge 0.

In colours to represent the L.M.S., G.W. or L.N.E. Railway Companies' rolling stock. Price, complete in strong box, **25/–.**



No. 1 Tank Goods Train



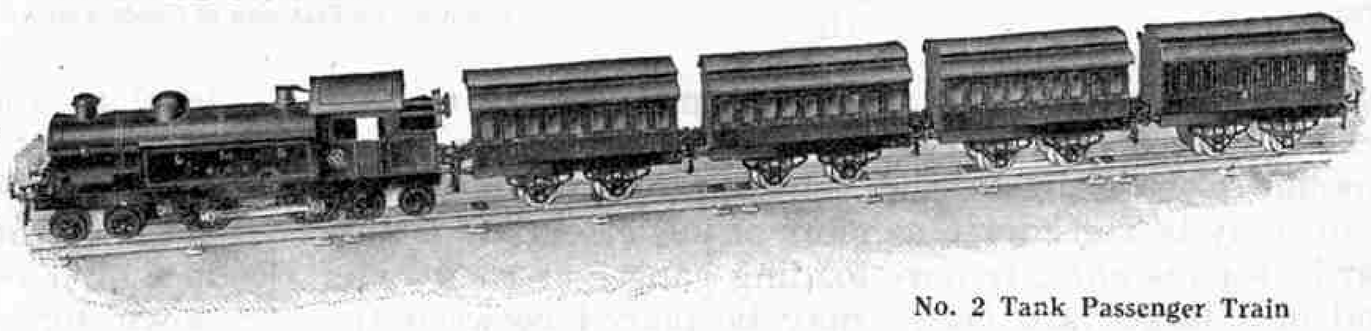
No. 2 Tank Goods Train

Hornby No. 2 Tank Goods Set

The rolling stock of this realistic goods train consists of a No. 2 Tank Loco, Hornby Wagon, Petrol Tank Wagon, No. 1 Cattle Truck, and Brake Van. The Loco may be braked and reversed from the track—which forms a circle 4 ft. in diameter—or from levers in the cab. The No. 2 Hornby Tank Loco is 11½ in. in length and is fitted with leading and trailing four-wheeled bogies. Gauge 0, in colours to represent the L.M.S., G.W. or L.N.E. Railway Companies' rolling stock. Price, complete in strong box, **45/–.**

Hornby No. 2 Tank Passenger Set

This set contains a No. 2 Hornby Tank Loco, three Passenger Coaches, Guard's Van, and set of Rails to form a circle 4 ft. in diameter. One of the Rails is fitted with levers by means of which the Loco may be both braked and reversed from the track. Gauge 0, in colours to represent the L.M.S., G.W. or L.N.E. Railway Companies rolling stock. Price, complete in strong box, **45/–.**



No. 2 Tank Passenger Train

FROM ALL MECCANO DEALERS

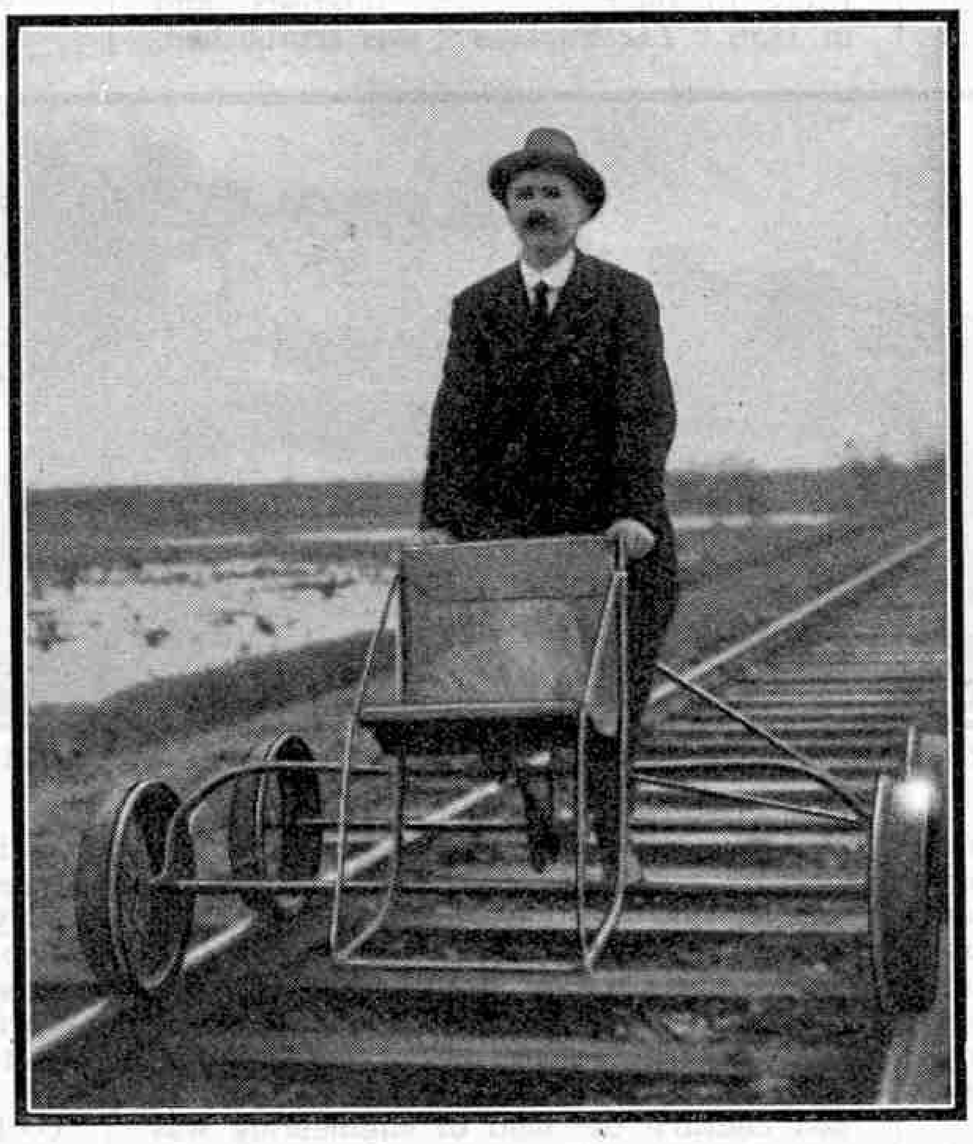
Cycling on the Railway!

The Railway Bicycle is Extremely Useful

by R. D. Gauld

ALTHOUGH the curious-looking machine shown in the accompanying photograph is called a bicycle by the men who use it regularly, the term is not correct because the machine has four wheels instead of two. Strictly speaking it should, one supposes, be called a "quadcycle," but for our present purpose we will continue to call it a bicycle because in a great many respects it resembles the ordinary "push bike."

The rail bicycle is extremely useful on railways where there is only a scanty train service and where the inspectors and engineers find it difficult to cover their districts in reasonable time. The permanent way inspector likes to go over every part of his district at least once a month so as to make sure that the track, drains, fences, etc. are all in good condition. The district engineer, too, goes out on the line as frequently as his office duties will permit, usually to see some particular feature of the line, although he makes a general inspection periodically.



The procedure is to take the bicycle by train to the nearest station, where it is put on the rails and pedalled along the track as required. It is made as light as possible so that, if necessary, one man can lift it off the track out of the way of a train. The particular machine shown in the picture is in use in the West of Ireland on a single line railway. The flat-bottomed rails should be noticed, spiked direct to the sleepers.

There are two seats, the one behind being similar to that of an ordinary bicycle saddle and upon it sits the man who drives the machine. The front seat is made of cane to secure lightness, seat and back being all in one piece and supported by a tube frame, which also forms a foot rest. This seat is made detachable to facilitate stowing the machine in the guard's van of a train.

The bicycle is pedalled in the usual manner. It has a chain drive, but is geared much lower than an ordinary road machine. On the level on a calm day a speed of 10 miles an hour could be kept up for a considerable time, but on a day's working eight miles an hour would be found sufficiently strenuous. Handlebars for the comfort of the driver are provided but, of course, the machine is steered by the rails. There is also a brake that acts on the back hub, but as the bicycle is not fitted with a free-wheel there is no difficulty in stopping it.

The four wheels are of thin iron with wire spokes. A tendency to slip on the rails in wet weather was counteracted by placing a covering of old "Ferodo" brake lining on the heads, thus ensuring a grip at all times.

When the engineer uses the bicycle he usually sits in front with his inspector pedalling behind, but on a cold winter morning the writer has been very glad to let the inspector take it easy in front while he himself endeavoured to create some heat by pedalling vigorously for a mile or so!

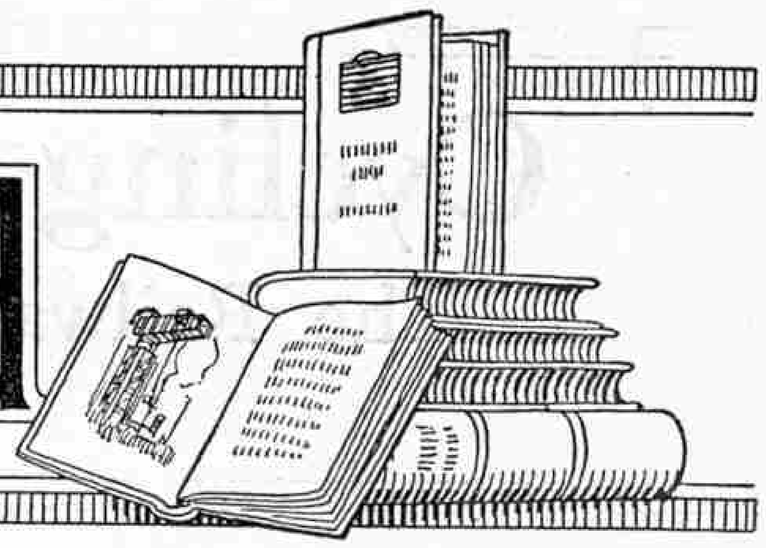
Before going into the section between two stations it is usual to ascertain from the signalman whether any trains are likely to be encountered but this, of course, does not do away with the necessity of keeping a good lookout. When there is a tunnel in the section the bicycle has to be signalled like a train and no train can be allowed into the section on the same line until the bicycle is clear of that section. When going round sharp curves in rock cuttings, or in other places where it is impossible to see very far along the track, a flagman is sent out to give warning of an approaching train, so that the bicycle may be removed in time.

On a fine day a trip on the bicycle is quite enjoyable, especially if one has the front seat! But on a wild, wet day, if the wind is blowing sideways or dead against the bicycle, it is far from pleasant.

It is difficult to travel faster than six miles an hour unless one is going downhill, and then the driving rain stings the face in a most unpleasant fashion. However, "railroading," as they call it in America, is not just a fine weather job. One takes the good with the bad and there are worse things than rail cycling even in the worst weather.

In many parts of the world there are great stretches of railway line passing through wild and rugged country and in such cases, owing to the infrequency of the train service, regular inspection of the line becomes a matter of the utmost importance. The railway bicycle, useful as it is, is not suitable for inspection work on such a scale, and its place is taken by specially-built cars propelled by internal combustion engines.

Books to Read



Readers frequently write to me asking if I can recommend books that are both of interest and of use. On these pages I review books that specially appeal to Meccano boys. I do not actually supply these books, which may be obtained either through any bookseller or direct from the publishers.—EDITOR.

"The Iron Road"

By CECIL J. ALLEN, M.Inst.T.
(John F. Shaw & Co. Ltd., London. 6/- net)

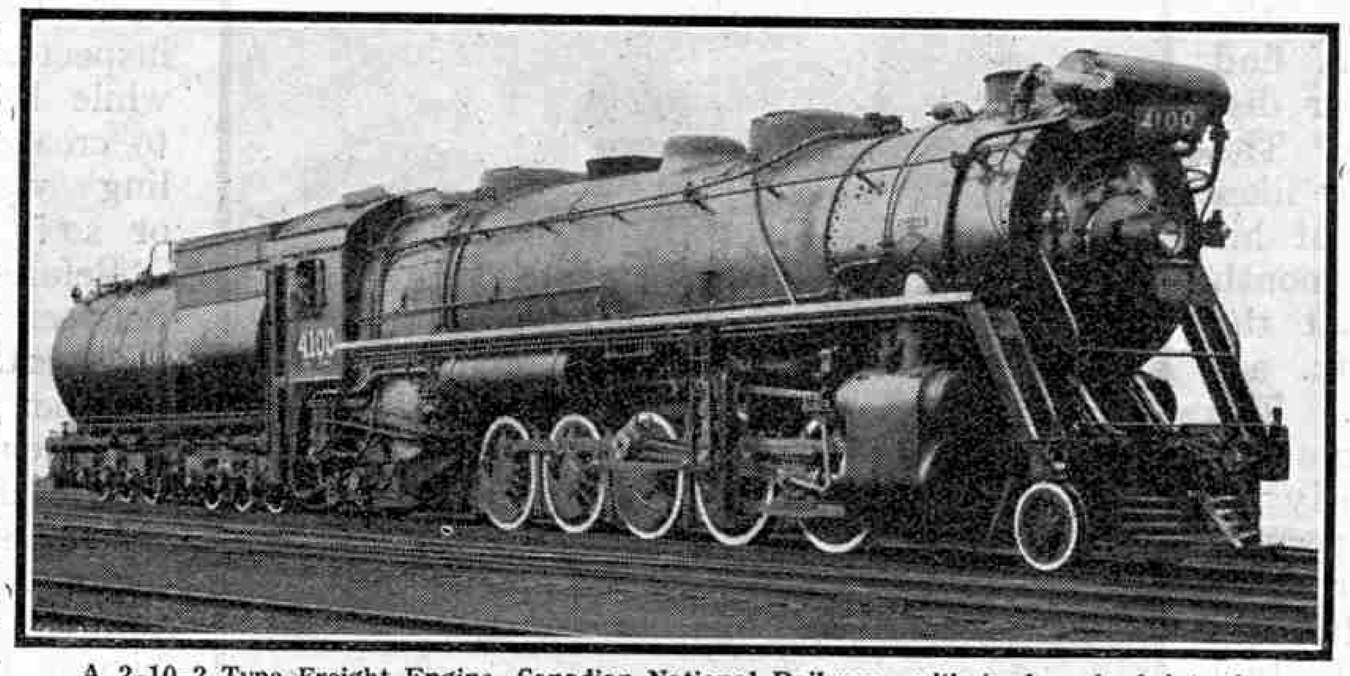
Mr. Cecil J. Allen, whose splendid series of articles on Famous Trains began in the January "*M.M.*," is a recognised authority on railway topics in general and therefore all his publications are of value. It is probable that he has produced nothing better than the present volume, which is certain to be greeted with enthusiasm by readers of the "*M.M.*"

Many popular books on railways have been published during recent years and while some of them have been thoroughly well written, many have been little more than repetitions of previous books. For this reason Mr. Allen's latest book is particularly interesting, in that in many respects it leaves the beaten track. In dealing with railway building, for instance, the author tells us exactly what is in the mind of the engineer who plans the line, and explains the various considerations that influence his decisions. Proceeding on similar lines we are shown how tunnels and tubes and bridges and viaducts are planned and constructed, and all railway enthusiasts will welcome the particularly interesting chapter dealing with railway stations and the handling of passengers.

Having dealt with railways in general, Mr. Allen passes on to locomotives and their work. The various mechanisms are simply but adequately explained and we are told why certain types of engines are more suitable than others for certain work. Subsequently the famous express trains of the world are passed in review, and one is particularly glad to notice that a whole chapter is devoted to freight trains and their work, this being a branch of railway operation that so many popular writers practically ignore. Mr. Allen clearly has a warm place in his heart for the sombre-hued giants that haul these trains.

The book is extraordinarily well illustrated. In addition to a number of full-page coloured plates there are some 200 photographs showing practically every phase of present-day railway operations.

Our only regret is that such an excellent book as this should be without an index. The detailed list of contents affords some compensation in this respect, but the value of the book would have been appreciably enhanced by a complete index and a detailed list of illustrations.



A 2-10-2 Type Freight Engine, Canadian National Railways, with twelve-wheeled tender
(From "The Iron Road," reviewed on this page)

"The Engineer," 1856–1927

The history of any successful institution is always of interest and this is particularly so in the case of a newspaper.

When Europe had recovered from the distractions of the Napoleonic wars, there commenced a remarkable period of development in mechanical engineering. It was not long before engineers began to feel the need of a newspaper devoted entirely to their work and interests, and in 1856 "*The Engineer*" was established. The paper met with success from the first and by wise guidance it has gradually reached the position of eminence that it occupies to-day.

From the outset "*The Engineer*" set out to cover the whole field of engineering and it continues to do so to-day—but with what a difference! In the fifties of last century the field of engineering was very limited. To realise this one only need remember that motor vehicles and the aeroplane were things almost unthought of! In spite of the vast field of to-day, however, this fine paper deals with every kind of engineering progress and development, not only in this country but all over the world; and while technical matters receive most consideration, scientific, commercial, and industrial aspects are not forgotten.

"*The Engineer*" has just celebrated its seventy years of success by the publication of a booklet of a specially interesting nature. This booklet is divided into eleven sections, each dealing with a particular branch of engineering—metallurgy, the machine shop, civil engineering, the locomotive, etc. Each section consists of a brief but interesting little review of its particular branch, illustrated by an excellent and splendidly reproduced drawing by Mr. J. Gilroy. No one can read through this little booklet without realising the enormous range of modern engineering and at the same time marvelling how one newspaper can deal week by week with the whole field of work.

A copy of the booklet will be sent to any reader who applies for it, at the same time mentioning the "*Meccano Magazine*," but early application is advisable as the supply is limited. Applications should be made to "*The Engineer*," 33, Norfolk Street, London, W.C.2.

* * * *

"The Pearl Lagoon"

By CHARLES NORDHOFF. (Dent. Price 6/-)

In the preface to this book of thrilling adventures in the South Sea Islands, the author tells us that he knows the islands, the pearl-divers and the mode of working well, and can vouch for the genuineness of the story's atmosphere. Having read only a few chapters of the book one is convinced that such a preface was really unnecessary, for none save a writer with intimate knowledge of the islands could write so engrossing a story with such a wealth of detail—he would be on ground too insecure for the most daring writer.

Amongst many other things of interest the author tells the secrets of the natives' success in diving to great depths, when, equipped only with diving goggles, they are able to remain under water for two minutes and longer. He tells, also, how their diving canoes are built; how the various enemies of men that inhabit these waters are fought; how different fishes are caught, and—even more important—cooked! We even learn the secret of how the oysters are searched for pearls—in fact the book is full of most valuable information that is of the greatest interest.

As for the story itself, it deals with a boy of 15 who, given the chance of a lifetime, took it, with the result that he sailed to these magic islands in charge of his uncle, to make a fortune from mother-of-pearl and pearls. He finds many true friends among the natives and with one particular friend of his own age, has many thrilling adventures. He dives for pearls; helps to fight sharks; learns to fish by native methods at night; and, best of all, the two boys find a real treasure of great value. When a great store of the valuable gold-lipped shell has been collected, pirates appear on the scene, and it would seem that all is lost, but thanks to the ingenuity and courage of our hero and his friends, all ends well, although not before there has been a fight that rivals in thrills the single-handed under-water fights with sharks that occur earlier in the tale.

The book is illustrated with four plates and altogether will be warmly welcomed by the reader of adventure stories.

"Sea Ventures of Britain"

By Commander Taprell Dorling
(Pub. by W. Collins, Sons & Co. Ltd. Price 8/6)

In this book Commander Taprell Dorling tells of the voyages and discoveries of the most famous ocean explorers in history. His heroes include Sir Francis Drake, Sir John Hawkins, Sir Martin Frobisher, William Dampier, Captain Cook, Lord Anson, Sir John Franklin, and Captain Scott. He endeavours to give us a picture that is not only historically accurate, but also one that presents a correct idea of the world in which these old seamen lived, of the ships in which they voyaged, and of the manner in which they made their conquests.

No one can read such stories as these without feeling a thrill of pride and without realising our debt to those who were pioneers of exploration. Although dealing with the greatest British explorers, the author does not forget to pay his tribute to "the lesser men who have no monuments to commemorate their deeds, no books wherein their doings are recorded," and to the "hosts of seamen who have ventured to the uttermost parts of the earth to return in due season to add their little contribution to our knowledge of the outer world and its resources and people. . . . It is to the persistent efforts of these obscure seamen, from captains to the men before the mast, equally as to the successes of those whose names are bywords in our language, that we are indebted for our present knowledge of the globe, our commercial prosperity, and our greatness as an oceanic empire."

The text is excellently illustrated with drawings (the work of Mr. Cecil King, a well known marine artist), of the ships in which the venturers sailed, pictures of the explorers and several maps. The book is not only useful but makes most thrilling reading and it is to be recommended to those of our readers who are interested in the sea and in adventure.

* * * *

Lord Birkenhead

By "Ephesian." (Mills & Son. Price 10/6)

The life of Lord Birkenhead is full of interest, more especially as he commenced his career in a comparatively humble way and rose to occupy the highest offices in State and Law. Although one of the outstanding personalities of to-day, he began life as plain Frederick Edwin Smith and it is interesting to learn that when he was raised to the peerage (in 1919) he took as his crest the Latin motto "*Faber meae fortunae*," which may be translated as "The Smith of my own Fortune," thus hinting with pride that he had fashioned a splendid career by his own efforts. In his early days he had little else than his hopes and ambitions, and life was a great adventure, and it is these times, when the fight raged most fiercely, that seem to be more interesting than the days when the battle was won.

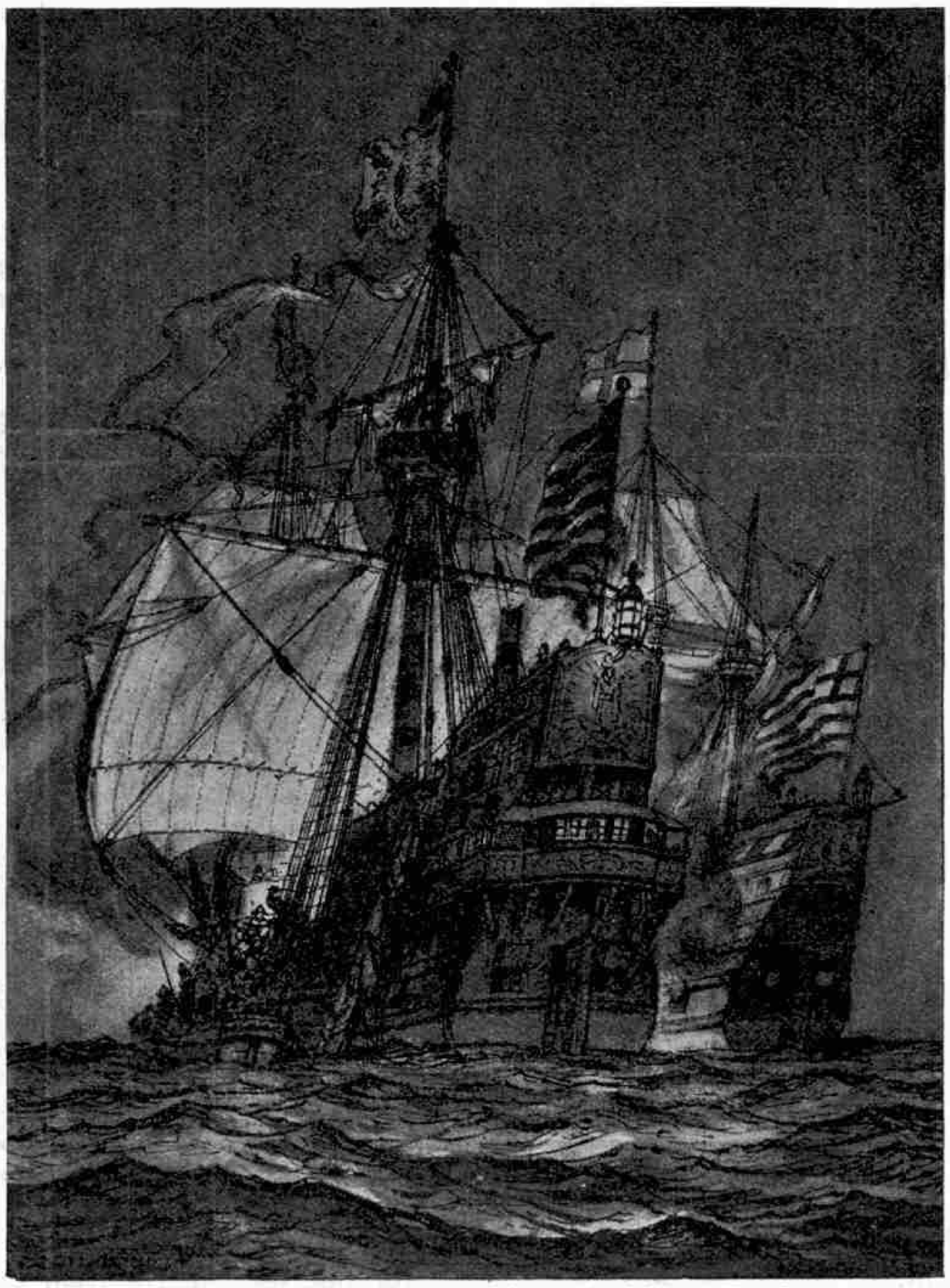
F. E. Smith was born in Birkenhead on 12th July 1872. His father was a barrister, and his maternal grandfather, a miner in a Wakefield pit, was the champion heavyweight boxer of the Yorkshire collieries. His father's father founded a land agency business in Birkenhead and was sternly religious. He discovered one Sunday that his son (Lord Birkenhead's father-to-be) who was then 17 years of age, had been out skating. Meeting him on the doorstep with "You have no place in a Christian home" he locked the door in his face. The boy crossed the Mersey, enlisted as a private in the regular army, and in eight weeks was on his way to India with his regiment. Here he took part in the fighting on the northwest frontier, became a Sergeant-Major at the age of 21, and before long was earning an income of £800 a year by teaching classics and mathematics to his officers' children! When he left the army he read for the bar and became a barrister on the Liverpool circuit. His service in the tropical heat of India had affected his health, however, and he died at the early age of 43, leaving a family of five children of whom "F.E." was the eldest.

On leaving school "F.E." went to Oxford where he became known as "Don't-care-Smith," a nickname that has stuck to him ever since. He was elected to Parliament in 1906 and his maiden speech in the House of Commons made him famous in a night. As a barrister, and the youngest K.C. and bencher of his time, he became leader of the young Tories.

During the War he saw service in France, was recalled to be appointed Solicitor-General and then Attorney-General. Later he became the youngest Lord High-Chancellor of modern times, and was subsequently appointed Secretary of State for India—and all this before his 53rd birthday!

He is a standard authority on international law, has written a score of books, and is a very enthusiastic yachtsman. In addition to being a good amateur boxer he was also an all-round athlete and one occasion, when he was 21 years of age, undertook for a wager a non-stop walk from Birkenhead to Llandudno, a distance of 60 miles, which he covered in fourteen hours at an average speed of 4¼ miles per hour. He also played Rugby and Tennis in which latter game he still retains a keen interest, having three courts at his house at Charlton.

We conclude this brief review by quoting from an inspiring speech he made last summer at his old school, when he said: "My advice to you is to meet success when it comes to you like a gentleman, and to meet disaster like a man. . . . While you are young cultivate the habit of industry . . . side by side with industry cultivate the care of your bodies and attention to those games which will keep you young and fit as you grow older. You will find that you are able to work better just in proportion as you will play better among your contemporaries and those among whom your lives will be spent"—a characteristic truth.



The "Cacafuego" taken by Drake in the "Golden Hind" (From "Sea Ventures of Britain" reviewed on this page)

* * * *

Interesting New Books

We hope to deal with the undermentioned books in an early issue.

"THREE MEN DISCUSS RELATIVITY"
by J. W. N. Sullivan
(Messrs. W. Collins, Sons & Co.), 7/6

"THE STRENGTH OF ENGLAND"
by George F. S. Bowles (Methuen), 8/6

"RADIO YEAR BOOK" (Pitman), 1/6

"THE SOUTH SEAS OF TO-DAY"
by Major A. J. Douglas, F.R.G.S. 21/-

"THE FIRST WORLD FLIGHT"
by Lowell Thomas. 24/-

"PRACTICAL GLASS MANIPULATION"
by D. B. Briggs, M.A.
(Crosby, Lockwood & Son), 2/6

"ARCHITECTURAL BUILDING CONSTRUCTION" *by* Walter R. Jaggard.
(Cambridge University Press). Price 10/6

FROM OUR READERS

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

Down a Tin Mine

We arrived at the mine just before 10 o'clock and proceeded to the manager's office. They were not quite ready for us to go down at the time, and so we were shown the engines at the top. First we saw the winding machinery for controlling the cages, and then the inside of the huge pump beam engine.

Having seen this machinery, we returned to the office to prepare for descending the mine. We all had to undress and don special clothes and boots, and we were each provided with hard felt hats which were covered with resin.

When we reached the shaft head, some of us were provided with small acetylene lamps and the rest with candles. The cage then came up and we all crowded in. A man then pulled a lever which rang a bell in the engine house and we began to descend.

The mine was 1,400 ft. in depth and it took us a minute to reach the bottom, as we were being lowered slowly. The miners go down in half a minute. At length the cage stopped and we got out and began to walk in single file along a narrow tunnel with a set of rails in.

"*M.M.*" readers visit a Tin Mine. The party in their special clothes before descending the shaft

It was very dark, the only light being from our lamps and candles, and we were walking in two or three inches of water lying between the rails. At frequent intervals were boarded up shafts filled with ore which had been brought down by blasting.

A little further along, we entered a sort of cave in which was a drilling machine. This was in the shape of a long fairly thin hollow rod, and is used for testing the ore ahead. It is driven a great way into the rock and a sample of the rock it passes through is pushed back inside the tube. We left this cave-like chamber and proceeded past a waterfall in the mine. It looked very pretty in the dim light. Then we arrived at the end of the tunnel where the miners were just going to blast to extend it. After watching for a minute, we returned past the waterfall and found ourselves at the shaft once more. We all squeezed into the cage and were soon rushing upwards. While travelling fast up to the middle of the shaft, very little motion was felt, but when slowing down towards the top, the cage began to rattle a great deal. (*Cont. on page* 315)

A Visit to an Aerodrome

Along with six other members of our small model aeroplane club I recently had the privilege of paying a visit to an aerodrome.

My dad drove us there in his car and presented the pass that we had been lucky enough to obtain. We were shown on to the 'drome and the first aeroplane we saw was an elementary training machine, the Avro type 504K, fitted with a rotary engine of between 100 and 140 h.p. One by one we gingerly peered into the cockpit, a most difficult place to put oneself, and we were aided by an Air Force officer who explained to us the uses of the various levers, instruments and switches.

Next we came to a more advanced machine, the de Havilland type 9A, fitted with a 400 h.p. "Liberty" engine and weighing, fully laden, about 4,800 lb. Meanwhile a Bristol Fighter with a Rolls-Royce "Falcon" engine of 275 h.p. was looping, rolling, diving, side-slipping and doing other interesting manœuvres.

Then we saw a Gloster "Grebe" with a 385 to 425 h.p. Armstrong-Siddeley "Jaguar" engine, similar to the one used in Sir Alan Cobham's historic flight. She was being cleaned, as her engine was throwing out an excessive amount of oil.

Next we were taken into a workshop where there was a constant roar of machinery and many engines were in parts or being overhauled. It seemed as if they consisted of thousands of parts. Afterwards we passed through many other hangars also extremely interesting, but space does not permit me to describe them. Subsequently we came to the charred wreckage of the American machine that crashed at Whiteleafe, Surrey. The twisted engine, the burnt propeller, the smashed framework and, most of all, the pilot's leather coat were truly a ghastly sight.

Various machines were in sight all the time including a Gloster "Gamecock" (described in the October "*M.M.*"), so we were never without something to keep us thrilled. Finally we were invited to tea, and we gladly accepted the invitation for as may be supposed we were all very hungry!

Reluctantly we entered the car and made our way home, having spent an afternoon of intense interest and one that we are not likely to forget. G. N. SERGEANT (Purley).

A Glimpse of Adelaide

South Australia became a British possession in the year 1836, and a few years later, under the sole direction of Colonel William Light, the building of Adelaide, on the site chosen by him and according to his plan, was commenced. It is entirely due to Light's far-sightedness and ingenuity that Adelaide has for years been known as one of the best planned cities in Australia.

Adelaide, the "Garden City," seen from the suburbs

Adelaide is noted for its many gardens, which can be seen in the city and all its suburbs, making everything look fresh and clean. For this reason, the city is named the "Garden City."

The main street, King William Street, runs from north to south through the centre of the city, the other streets branching off at right angles. The busiest portion of the city is the northern end where most of the large shops, buildings, and offices are situated. North Terrace, which marks the northern boundary of the city, is where many of the most important buildings are to be seen, including Government House, the University, the Art Gallery, the Museum, Public and Childrens' Libraries, and so forth.

The buildings just mentioned are to the east of the main road, and a beautiful strip of lawns and gardens stretches for a long distance down the northern side of the street. Parliament House is also in North Terrace, but is to the West of King William Street. To most people, however, North Terrace recalls vivid memories of dentists' chairs and doctors' rooms, for this is the favourite "haunt" of men of these professions. Going northwards one crosses the River Torrens by the City Bridge, and to the left can be seen the Oval, which, English readers will remember, has been the scene of many Third Tests between England and Australia. Further on is the Anglican Cathedral, after which the northern suburbs are reached. So much then for the city.

Adelaide is only a few miles from the Mt. Lofty Ranges : in fact the suburb in which I live (about four miles from the city) is in the foothills, and a few minutes' walk finds us in the hills themselves. An excellent way to see the scenery of the ranges is provided by the Tourist Bureau, which runs charabancs daily to the beauty spots.

In the spring the hills present a glorious picture resplendent with wild flowers of all descriptions, wattle, and stately gums. Occasionally along the road one may catch a glimpse of the city with its surrounding parks and suburbs, and, further distant, the sea from which may be seen a spiral of smoke from some vessel.

C. K. C. HARROP (Kingswood, S.A.)

Beachy Head Lighthouse

When I visited Eastbourne recently I was fortunate in being able to arrange to visit Beachy Head Lighthouse. Having climbed to the lower platform, I rested for a minute or two and then went up to the doorway by means of copper rungs set in the wall. In entering you have to grasp two handles and swing yourself inside.

The first room is a store room containing water tanks, although the main supply is pumped to the kitchen from the basement where it is stored. Next comes a workshop containing a block and tackle for lifting provisions and other necessities. This can be seen projecting at the side of the lighthouse in the photograph. The keepers' private luxuries are stored along with the official provisions in the next room, the pantry.

Next comes the kitchen, containing a bookcase, cupboards, fire-place and oven, and a sink with hot and cold water. Everything, even the bunks, is curved in order to take up the least possible space. A fine view of Eastbourne and the coast is obtained from the kitchen window, which is about two-thirds of the way up the tower.

Beachy Head Lighthouse

Still travelling upward we come to the bedroom, which is connected by a speaking tube to the lantern room so that the keeper on duty may communicate with his mate when his shift is finished. Although there are three keepers, only two are on duty at a time, each having two months on the lighthouse and then one month's shore leave.

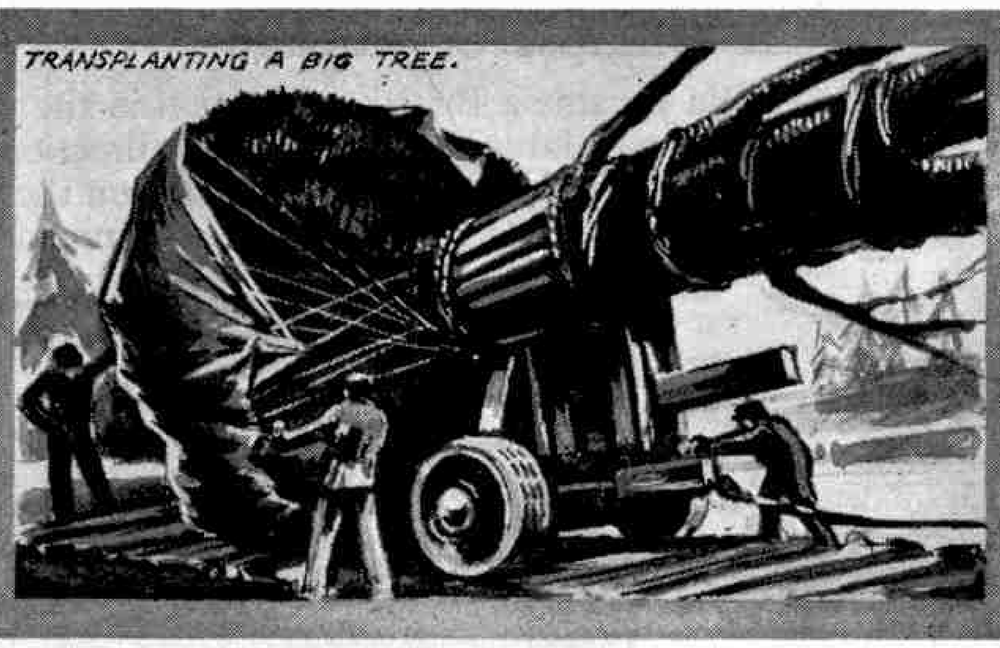
Necessities for the lantern are in the room next to the bedroom. Here are two tanks, each containing in its lower part air at a pressure of 60 lb. per sq. in., and in its upper part 1,000 gallons of paraffin. The weights of the clockwork that operates the lantern drop down a pipe in the centre of this room.

At last I reached the lantern chamber, which was quite dark on account of the black curtains placed round it to prevent the sun's rays from injuring the mechanism. The revolving part with its three compound lenses weighs four tons. It revolves on roller bearings at about walking pace and the lenses need one hour's polishing each day. There are three lamps of 50,000 candle power which are used in rotation, those not in use being cleaned thoroughly. At one side of the room is the fog signalling apparatus by means of which a charge of gun cotton is exploded every five minutes.

The lighthouse is 140 ft. in height and 50 ft. round at the base. The light can be seen for a distance of 16 miles. It is interesting to know that the tower sways 18 in. in a gale and the keeper is sometimes sea-sick!

F. HUGHES (Sheffield).

our wonderful world



A Romance of Apple Seeds

Four million barrels of American apples are landed at Liverpool docks annually for distribution throughout Great Britain, and most of these apples are grown on trees raised in America from seeds obtained at Old Swan, within a stone's throw of the "*M.M.*" offices in Liverpool. As this trade began with the importation of a mere 100,000 barrels, it is clear that the extension of the orchard at Old Swan to distant lands has met with the approval of two continents.

The magnitude of the fruit trade generally is enormous. As many as 100,000 packages of fruit are sold in Liverpool in one day, while the number of Valencia oranges cleared at the docks amounts to three million barrels, and of bananas to five million crates, annually. An interesting side-light on the war is given by the trade in Jaffa oranges. The Turks cut down the orange trees of Jaffa for wood, but the lost trees have now been replaced and the supply has been brought back practically to pre-war standard, with the result that there will be approximately four-and-a-half million boxes of these oranges brought to this country during the season.

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New Use for the Microscope

The use of the microscope as a detector of adulteration of foodstuffs is quite a routine matter nowadays, and about fifteen years ago Professor A. P. Laurie, of Edinburgh, used the instrument for distinguishing between the original oil paintings of the great masters and forgeries. In the latter case it was found that the brush strokes of each particular artist were quite as characteristic as finger prints, and when examined under the microscope allowed conclusions to be formed as to the genuineness or otherwise of pictures submitted to the tests.

The idea has been applied lately at the Imperial Forestry Institute to the identification of kinds of wood. The size and shape of the cells of growing plants show variations, and it is found that their characteristic structures can easily be detected in wood by microscopic examination of very thin sections, less than one two-thousandth of an inch in thickness. The results are recorded photographically, and photo-micrographs have been obtained showing the structure of the wood from more than 2,000 different kinds of trees that grow in forests in the British Empire, covering 685,000 square miles.

Tests of samples of alleged mahogany made by the experts of the Institute showed that in 170 cases some other wood had been substituted that did not even come from trees of the same family as mahogany! The advent of such a powerful and easy method of detecting substitution makes the outlook very black for the faked furniture dealer.

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Salmon's Journey from Atlantic to Pacific

A 10 lb. salmon has earned fame for itself and set a puzzle to the experts by finding its way from the Atlantic Ocean to the Pacific, a journey of at least 6,000 miles by the shortest possible route. It was one of a number of fishes that are liberated annually by the officials of the Canadian Fisheries Department, after attaching to their tails metal tags with the date and place of liberation and details of the fish itself marked on them. The object is to discover as much as possible about the life and habits of the salmon with a view to maintaining and increasing the supply of this valuable fish, but few would be prepared for the discovery off the coast of British Columbia of one of the fishes released on the East Coast of the Continent.

How did it get there? Did it follow the old route round the Horn, sneak through the locks of the Panama Canal in the wake of a ship, or follow the North-West Passage, through which Amundsen succeeded in sailing after centuries of unavailing human efforts? It will be even more interesting to know if there is a regular salmon route from coast to coast, or if this ten-pounder was an unusually adventurous specimen.

* * * *

When the World Will be Full

At the present time the population of the world is about eighteen hundred million, a more exact statement being impossible as there are several countries where a census cannot be taken. It has been suggested that eight thousand million is the limiting number of human beings which the world can support, and a calculation based on the rate of increase during the last fifty years leads to the belief that in 300 years this limit will be reached and the world will be full!

Dr. Albrecht Penck, a famous geographical expert, has worked out a picture of the probable distribution of the people of 300 years hence. Europe and Asia will only have a quarter of the total, instead of four-fifths as at present, and England, in particular, will have to lose about five million people as it will not be possible to import food from abroad. The greatest increases in population will be in Africa and South America, since careful preparation of the land will make these hot, moist countries capable of supporting three times as many people to the acre as more temperate lands. To Africa Dr. Penck assigns over two thousand million inhabitants—more than the whole present population of the world—while Brazil alone in South America will have twelve hundred million, so that nearly half the population of the earth will have concentrated in Africa and South America.

Prophecy on such matters is of course dangerous work. These calculations are based on present-day practice in the production of food and clothing, and do not take into account the improvements that almost certainly will be made in these essential matters. This much is certain—that an estimate made 300 years ago of the number of people the earth could support would be very much different from one made with a knowledge of present-day possibilities.

Stefansson, the famous Arctic explorer, has other ideas. He has made experiments showing that wheat crops can be grown with success even in Alaska, and development of these experiments will upset the ideas of distribution of population suggested above.

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The Earth's Week-end Rest!

Long before the news of an earthquake can be telegraphed to the other side of the world its occurrence is registered by a seismograph, the wonderful instrument that magnifies by two thousand times any movement of the earth. The sensitivity of this instrument is so great that it will detect very minor disturbances as well as earthquakes of the magnitude of the one that occurred recently in Japan.

This has been demonstrated in a curious manner with the aid of a large seismograph, weighing nineteen tons, that has been erected at the Institute of Terrestrial Physics at Strasburg. Examination of the records of this machine show that there are fewer tremors on Saturday night and Sunday than during the rest of the week, the earth apparently having a week-end holiday! The explanation is that large rolling mills and engineering plants in the neighbourhood of the city produce tremors in the earth that are easily detected by this sensitive apparatus, and the earth's Sunday rest simply follows the cessation of work for the week-end.

The tremors recommence on Monday morning as soon as the boilers are started, and by six o'clock, when the factories are once more in full working order, the machine begins to record earth vibrations almost equal in intensity to those produced by a distant earthquake. Their effects, too, are similar to those of mild earthquakes, for it has been discovered that these artificial earth waves are quite capable of injuring buildings.

They do not act, of course, in quite the same devastating way as natural earthquakes, but are harmful because of their continuity, the repetition of the vibrations slowly weakening the structure of a building.

Fighting the Snake Poison Menace

The risk of poison from snake bite is one that can practically be ignored in Great Britain, where the only poisonous snake, and that a comparatively rare one, is the viper. In many other parts of the world, however, snakes are a very serious menace indeed. This is the case in Central and South America, the home of an enormous variety of venomous snakes including the gigantic boas and anacondas; in India, where the well-known cobra lives, and even in the more thickly populated United States where the rattlesnake and the still more dangerous copperhead are to be found. In India more than 1,000 persons are stated to be killed annually by snakes, the majority being bitten by cobras; while in the West Indies the dreaded fer de lance, a viper that finds cover and protection among the huge canes of the sugar plantations, is responsible for a great number of deaths among the black labourers.

The solution of the problem of dealing with these poisonous snakes appears to have been found by Dr. Afranio de Amaral, a Brazilian expert, who for some time has conducted a remarkable snake farm at San Paulo. Dr. Amaral must be regarded as the world's foremost authority on snakes and their poisons, and as a result of the experiments that he has made with the snakes in the pits of his unique farm, he has produced an antitoxin that has proved to be effective in cases of poisoning by snake bite.

The first step in the preparation of the antitoxin is to pin down a selected snake by means of a long stick, and grasp it behind the head so as to keep the deadly fangs away from the operator's hand. The angry snake is then made to bite a thin cloth stretched over a container, and the poison sacs of its head are pressed to force out as much venom as possible. The venom thus extracted is diluted and injected into horses, at first in small quantities, so that gradually they become immune to the effects of the poison. From the blood of the animals so treated the antitoxin is then made.

The value of Dr. Amaral's work cannot be too highly estimated, but to be successful the antitoxin has to be applied with the utmost promptitude. This is not easy so long as Brazil remains practically the only source of supply, but steps have been taken to improve matters in the United States by the adoption of Dr. Amaral's methods at the Zoological Park in New York. It is hoped that soon it will be possible to buy standardised snake serum over the counter of any American drug stores.

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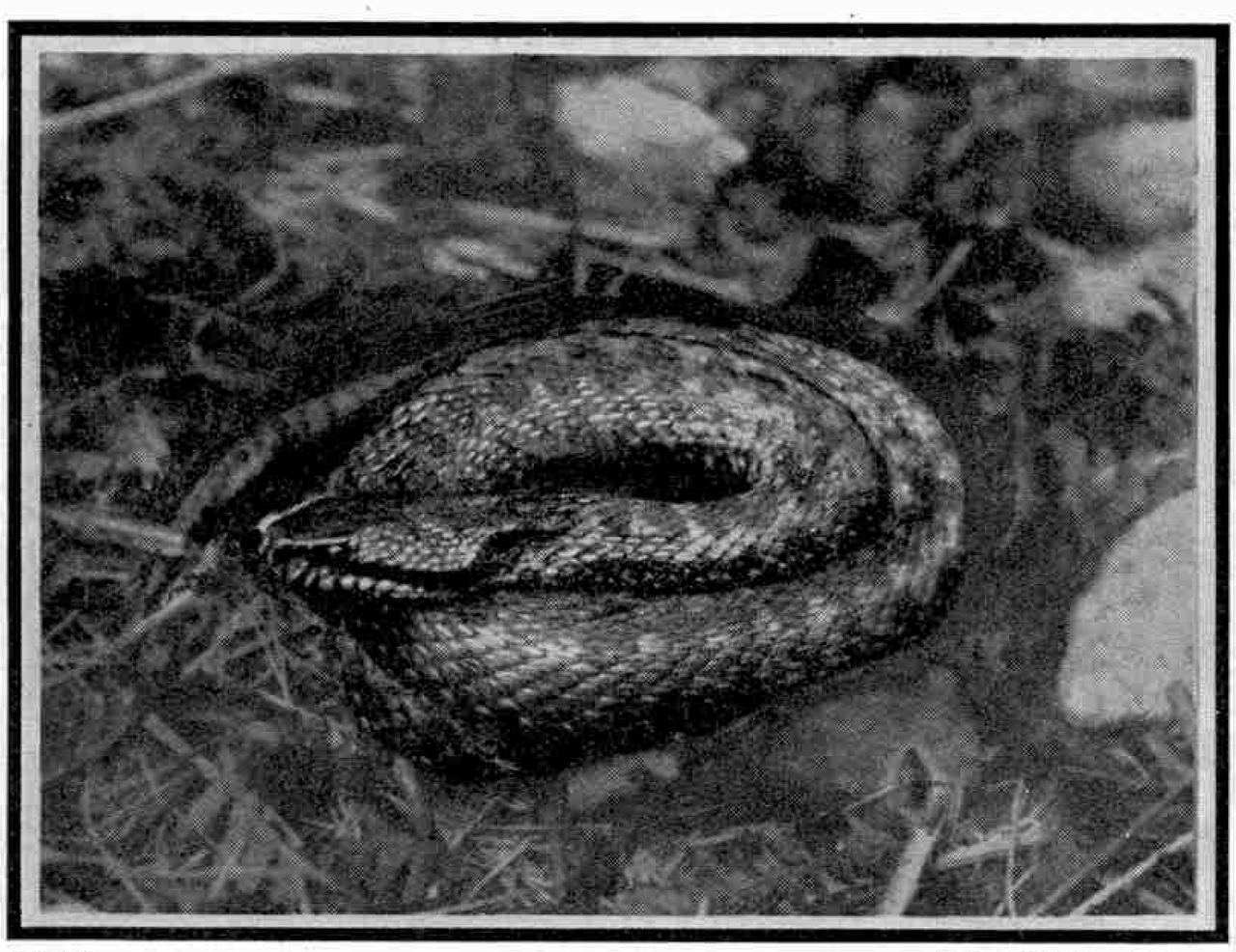
Production of Neon : A Disputed Claim

In a paragraph entitled "Modern Alchemists" on page 18 of the January *"M.M.,"* reference was made to the claim by Professor Baly and Dr. Riding that they had produced the gas neon by passing sparks through a mixture of oxygen and nitrogen. Readers will be interested to learn that this claim is not being allowed to pass unchallenged, and criticism by Dr. Lawson of Sheffield University illustrates the difficulties that beset the path of scientific research, and also the extraordinary delicacy of the tests and methods used.

Dr. Lawson quite agrees that the appearance of neon inside the tubes used was not due to leakage of any ordinary kind, but points out that the rare gases helium and neon are capable of diffusing through hot glass. In support of this he refers to many



Photo] [*Scientific Illus. Bureau*

A Viper, showing distinctive markings

experiments by various English and Continental scientists in which this diffusion has been observed, together with experiments of his own in which he heated an electrical discharge tube to 200°C. for 36 hours, and then found that a small quantity of helium was present in the tube. Believing that this diffusion may explain Baly and Riding's results, he suggests that the question can be settled by a repetition of their experiments with the gases in a tube immersed in mercury or a stream of water, to exclude the possibility of diffusion taking place.

In the experiments already referred to Dr. Lawson found that the quantity of helium that had diffused through the glass into the tube was about one ten-millionth of a cubic centimetre! This is an extraordinarily small amount, but the methods used were so sensitive that he could have detected even one-tenth of it.

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Marvels of a New Metal

A new metal known as solium and composed of oxides, earths, and metals known as the platinum group, has just been perfected in a laboratory at Bridle Lane, a street at the back of the Regent Palace Hotel.

The metallurgical discovery was made by Mr. T. D. Kelley, who is a civil engineer and a chemist. As long ago as 1907 Mr. Kelley indicated that a metal was wanted that would keep its strength in white heat, and withstand the fumes and vapours of nitric acid and superheated steam.

Solium, Mr. Kelley claims, can be made harder than steel, or as soft as lead; there is no degree of malleability to which it may not be reduced; and no purpose whatever for which platinum is used which solium will not serve equally well.

The Rubber Problem in America

In "Our Wonderful World" in the *"M.M."* for November last reference was made to the romantic history of rubber, and it was mentioned that 60 per cent. of the rubber industry was in British hands. Of the annual production of rubber in the world, one thousand million pounds, or 70 per cent. is used in the United States, and it is certainly a curious thing that although the old world owes the discovery of rubber to the new, the greatest state in the new world has to come to the old for its rubber!

The existence of rubber in Central and South America was known to the first Spanish explorers of these countries, and as early as the days of Columbus it was remarked that the Indians of Hayti played games with a ball made of rubber. The Spaniards soon discovered other uses for it, and they are even reported to have waterproofed their clothes with it in the 15th century, 400 years before the great invention of the mackintosh. To-day the planters of British Malaya control prices and output.

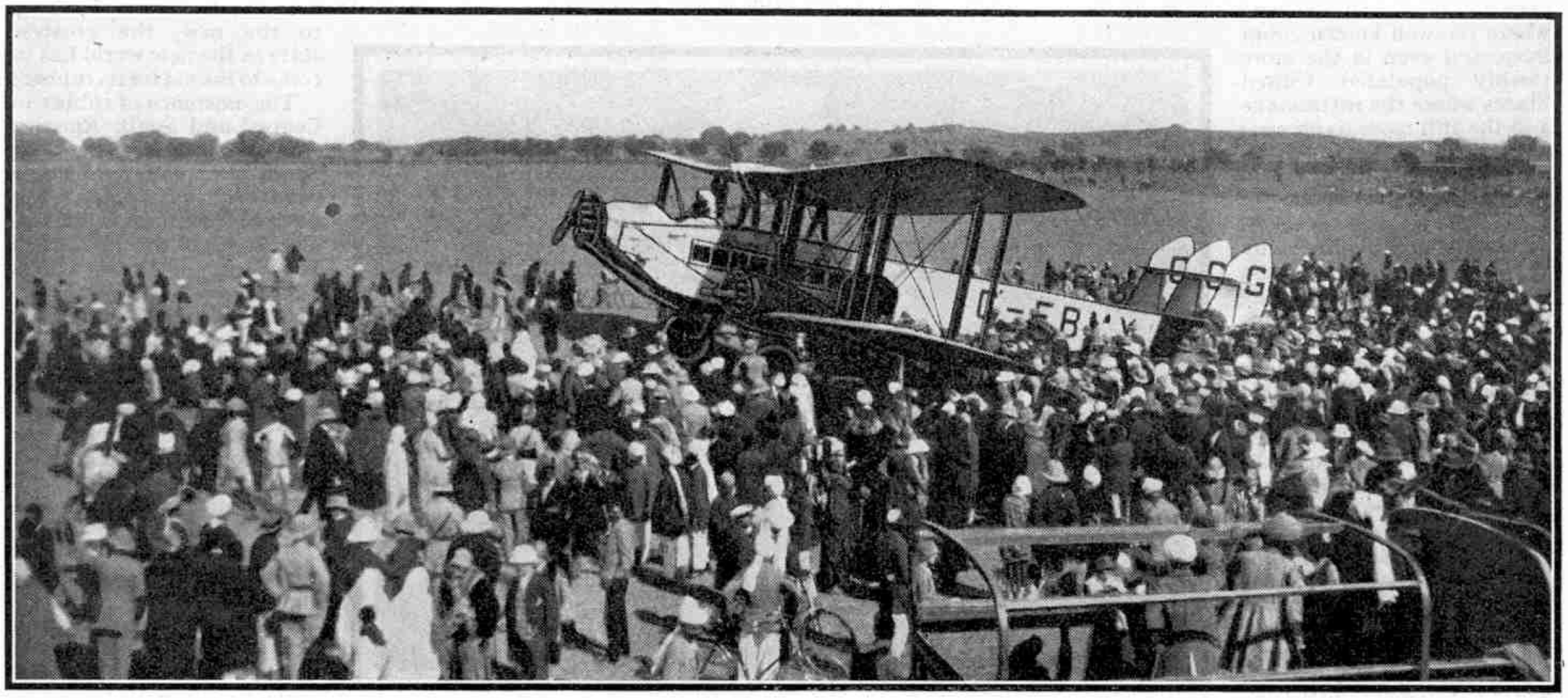
The Americans are not satisfied with the position they occupy as the largest users and at the same time non-producers, and besides taking ordinary business steps to deal with this situation, they are attempting to solve the problem of finding supplies of rubber within their own borders. In guayule, a plant that is native to Mexico and Texas and can be grown successfully in California, they think that they have discovered a source of natural rubber that will give a quality suitable for motor tyres, the use to which most of the imported rubber is put. Unfortunately, this plant cannot be tapped as in the well-known process used with ordinary rubber-bearing plants, but must be ground up and destroyed in order to extract the rubber, and this cannot be done until the plant is four years old.

In spite of this drawback, guayule seems to offer the best means for the home production of rubber in the United States. A start was made in California where 10 shrubs were planted 14 years ago, all of which had been carefully selected by an expert from millions of shrubs in Mexico. It has been estimated that 4,000 square miles of guayule plantations will be necessary to produce annually a sufficient number of four-year-old trees to meet the present demand for rubber in the United States. The provision of this large area is not a very difficult problem, however, as the area of the state of California is 158,000 square miles.

A discovery that is possibly even more important is a new method of selecting and grafting rubber plants that has been evolved in the States. By adopting these new methods, trees have been developed that will yield 100 lb. of rubber per acre in their first bearing year, and up to 1,000 lb. per acre when fully grown; whereas the yield for 10-year-old trees on the plantations of the East Indies only averages 430 lb. per acre. In addition, steps have been taken recently by an American syndicate to develop rubber cultivation in Liberia, so it seems that the United States will gain a large share of rubber control.

4,000 Miles in 40 Hours!

The "Hercules" Flies from Croydon to Basra



This photograph, sent us by one of our readers (B. P. Mittra, of Delhi) shows the arrival of the "Hercules" at Delhi

AT 07.45 hours on 18th December last, all preliminaries having been disposed of, the three Bristol "Jupiter" engines of the de Havilland "Hercules" were brought to life through the medium of the diminutive starter engine and the first of the huge but beautifully proportioned Imperial Airway liners started from Croydon on its journey to the Near East.

Having made a farewell circuit of the aerodrome it headed south-eastwards and in a surprisingly short time was lost to view.

It must have been a most impressive sight for those who had gathered to view the departure when this heavily laden machine, after a very short run leapt into the air and moved so gracefully away on its epoch-making flight which has gone so much further to prove the value of aviation for bringing the far-flung Empire into closer contact with the Mother country.

The passengers included Sir Sefton Brancker, Air Commodore Weir and Mrs. Weir, and Capt. Gladstone of Khartoum-Kenya air route fame. Mr. Wolley Dod was in charge and I acted as second pilot, while the two engineers, Messrs. Woolger and Booth, ably assisted us.

Now let us follow the "Hercules." Shortly after leaving Croydon, the English coast was crossed, and the last portion of the Old Country to be seen was Dungeness. Very soon the little strip of turbulent water that keeps England at a respectable distance from the Continent was crossed, but without that unpleasant sensation so often experienced by many unfortunate travellers who unwillingly traverse its surface. An ever-changing bird's-eye view of beautiful forests and never-ending fields interspersed with rivers and picturesque odd-shaped villages, then we were at Le Bourget, alongside that Continental magnet Paris. However, no time for such frivolities now—a few formalities, a little fuel, and away again for Dijon.

Down to Romilly the elements were kind, but onwards to Dijon one felt sorry for the land dwellers. The whole country-side was white, and very shortly severe snowstorms were encountered over the Côte d'Or. However, the "Hercules" lived up to its name, and almost before one could realise it had happened, she settled down gently on what at the time almost resembled a lake. It was really Dijon Aerodrome, and it proved without enquiry that the weather for a number of preceding hours had been distinctly inclement.

At this stop refuelling operations were carried out on both machine and passengers—for the latter comfortably and with no great difficulty, but for the machine it was different, as the wind was so bitterly cold that the leather petrol strainers froze continually.

However, she was shortly in the air again, and proceeded to Lyon, which completed the first day's stage. Here the engines had their routine examination, the

All readers of the "M.M." are interested in the de Havilland air liners that are now flying so successfully between Cairo and Karachi. Their particular interest lies in the fact that these giant aeroplanes were named "Hercules" by readers of this magazine in a special competition held last August, those readers who suggested the winning name being awarded prize flights in "Moth" aeroplanes.

The accompanying article, which is reprinted by permission from "The de Havilland Gazette," concerns the flight of the first "Hercules" from Croydon to the temporary Eastern terminus of Imperial Airways Middle East Service. The graphic description of this flight was written by Mr. W. F. Warner, one of the Company's Pilots, who pays a high tribute to the reliability and comfort of the "Hercules."

tanks were filled, and she was put to bed for the night.

At this point it would be worth mentioning that notwithstanding the cold and elevation at which we had been flying it was noticed that as the passengers alighted from the machine each one proceeded to don an overcoat, although it was not raining. This merely goes to show how cabin comfort has been catered for and speaks worlds for the advances recently made in machine construction generally. Later, of course, in Palestine the heating apparatus was switched over to "cool air" and equal comfort was attained.

Leaving Lyon on the 19th in clear sunlight a good 50 miles of snow-covered country was traversed—then a land of swollen rivers and high snow-capped peaks. The scenery here was most impressive, rough and precipitous. At times, flying past sheer faces of rock on a level with the mountain top, the cliffs being only a few hundred feet from the wing tips and in the background snow-capped and sometimes cloud-capped monsters towering many thousands of feet into the sky.

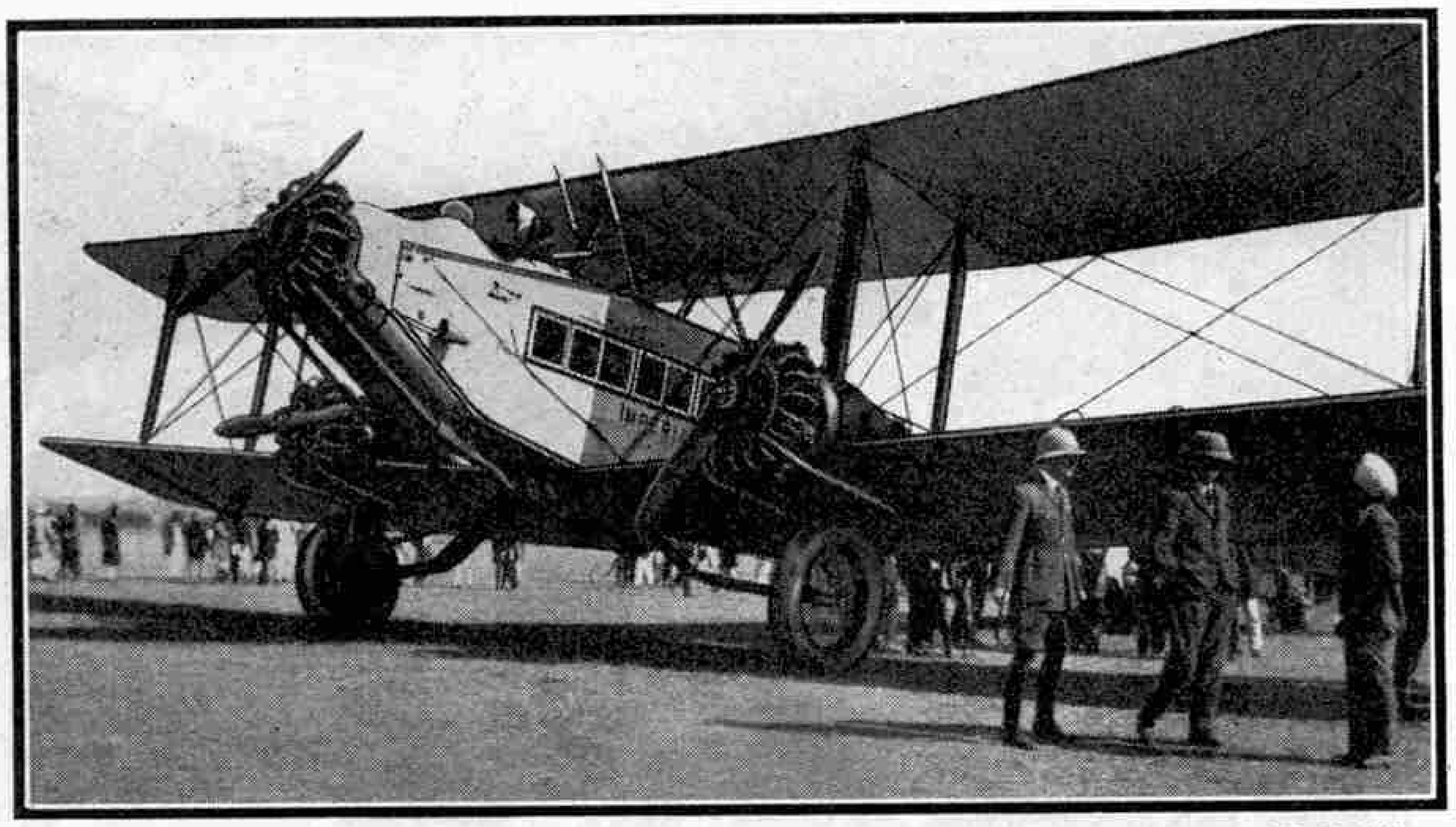
During this stretch to Marignane a most favourable wind was encountered which assisted us to our destination in record time. That afternoon some of us remained in the quaint old-time village where we were hospitably entertained by our host. Others went to call in Marseilles, while the rest decided to view the country-side, using the most primitive means of transport and in some cases suffering accordingly as it is a rough area, but well worth seeing even on foot.

The following day would have interested the most *blasé*. We left Marignane in perfect weather and proceeded towards Pisa, our next port of call. More perfect flying weather could not have been desired and soon we were treated to a unique view of such places as Cannes, Nice, Mentone and Monte Carlo. All were extraordinarily dainty and picturesque in themselves, but shown to perfection between a stretch of crystal clear sea of ever changing shades of blue in the foreground, colossal snow-capped mountains for a background, and overhead a sky that would put any Indian summer to shame. Genoa was somewhat off the course, but even in the distance a good idea was obtained of that beauty spot nestling at the top of a placid bay.

A good view of the Leaning Tower of Pisa persuaded one that it was far better viewed from above than below. However, little time was allowed for such thoughts, as within a minute or two we were on the ground out of the machine and rushed off to a very pleasant lunch by our Italian hosts.

A few days previously this aerodrome had been completely flooded by torrential rains, and was still in sorry condition. Even though smaller machines had to proceed very gingerly across it, the "Hercules," although four or five times their weight, made light work of it and did not attempt to sink, no doubt owing to the even distribution of weight on its two enormous wheels.

Having bid our hosts adieu, we proceeded on a straight course for Naples, which led across the outskirts of Rome. Viewed on a perfect afternoon from a few thousand feet Rome is a sight never to be forgotten, and is such that one could write pages. Picturesque and impressive as it is now, one could not help wondering what it must have been in the days of Vespasian. The Appian Way was clearly visible, too, as we made towards Naples, which we reached just before sundown, but nevertheless in time to climb above Vesuvius and look down into the crater where the little inner cone was belching smoke and flames.



Photo] [*B. P. Mittra*

The "Hercules" in the Aerodrome

One sees many enchanting pictures of Naples, but they are nothing compared with a view from the air on a calm evening when one sees it in its natural colourings—lights and shades which would defy the cleverest brush. The weather had treated us so kindly that everyone anticipated similar conditions on the following day. However, during the night Vesuvius had acquired a mantle of snow and a stiff breeze was blowing, and having proceeded some distance on our next stage to Catania, we encountered severe rain storms and head winds. The stage all the way along the coast was most interesting. It lay on our left, and by a stroke of good luck the weather lifted at the identical moment, giving us a fleeting glimpse of Stromboli towering majestically from the Mediterranean.

Passing the Straits of Messina we were soon slipping along the Sicilian coast, but, no doubt much to everyone's disgust, we were not permitted to view Etna as the peak was shrouded heavily in cloud. But compensation was forthcoming, as the following morning broke wonderfully clear and a beautiful view was obtained of the mountain heavily capped with snow towering above Catania, our picturesque resting place.

It was during this stage that the most adverse weather conditions were experienced, but the "Hercules" made light work of it all the way. Some idea of the wind may be estimated by the fact that after landing at Catania, gusts of wind were registered of over 40 m.p.h. No hangar large enough to house the liner was available, so she had to be carefully picketed in the open for the night.

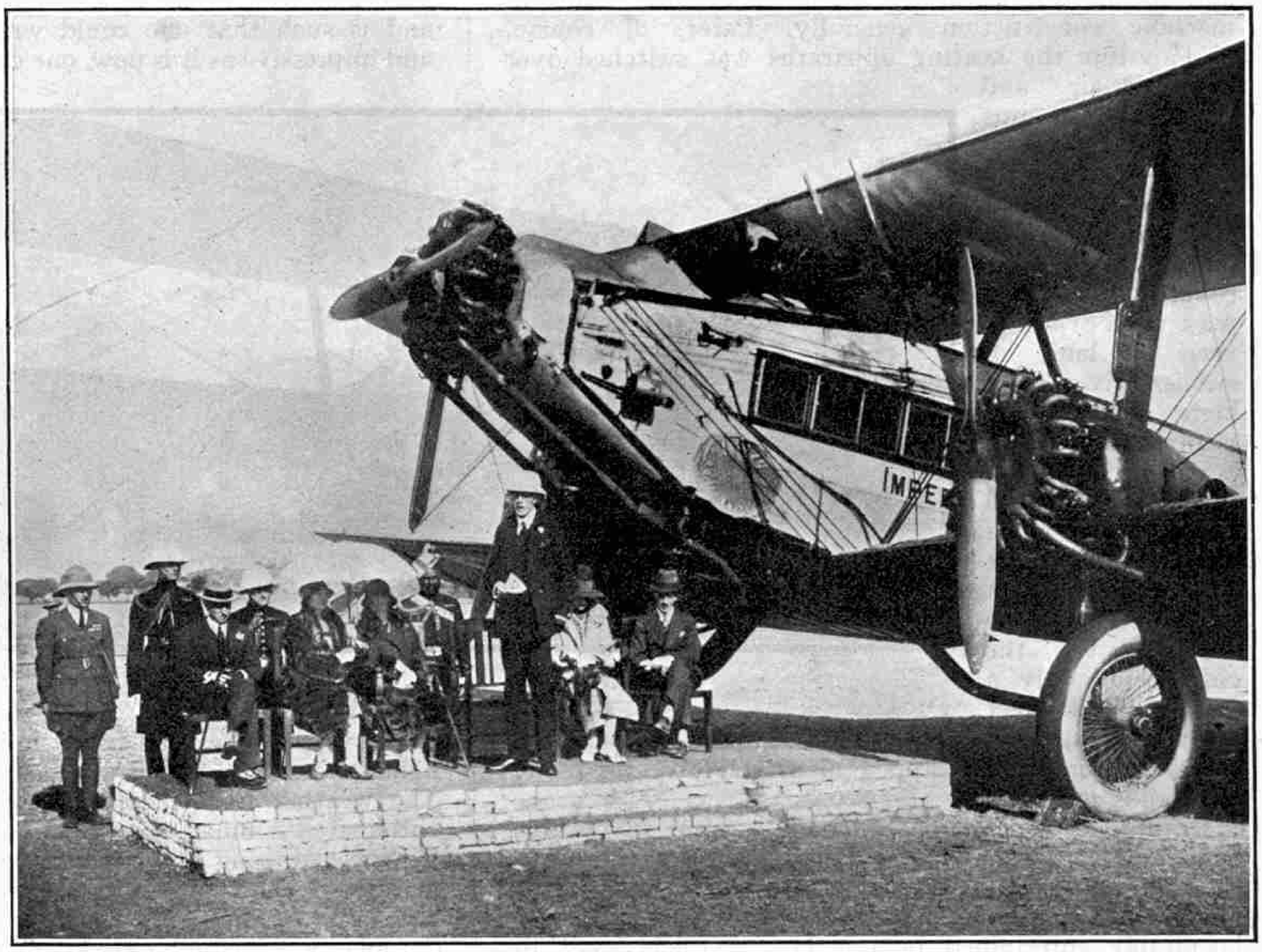
The following morning, having had the unique experience of sleeping in the shadow of the world's two most famous volcanoes, with also a view of Stromboli, all within twenty-four hours, we set off for Malta. The Headquarters of the Royal Air Force in this delightful little spot are at Calafrana, and here the passengers went their several ways while awaiting the arrival of the second Imperial liner which was due to join us that day.

In the course of an hour or two she was signalled and shortly after was drawn up alongside her sister ship, making a most imposing sight amongst the array of Fleet Spotters and torpedo carrying craft of our hosts.

The following day, 23rd, an early start was made for Khoms in Tripoli, which was reached in time for an early lunch very kindly provided by the Italian Air Force. Having viewed this isolated station from the air one can only make a rough guess at the enormous trouble our hosts must have experienced to produce this exceedingly palatable nine course meal for hungry travellers. However, it was typical of the enthusiasm shown wherever we landed in Italian territory.

Having filled up, we departed for Benghazi, due East across the bay over 350 miles of water and out of sight of land all the way. This was the most monotonous stretch of all, but the welcome at Benghazi went a long way to make up for that.

We stayed the night at this quaint spot and were treated to a royal banquet with specially arranged dance. It is quite unnecessary to state, we were still in Tripoli, under the Italian Flag!



Courtesy] [*The de Havilland Aircraft Co. Ltd.*

The Christening Ceremony—The Viceroy of India, Lord Irwin, speaking at Delhi when the "Hercules" was named "*The City of Delhi*" by Lady Irwin

On 24th December, Christmas Eve, we reluctantly departed from this our last port of call in Italian territory on the final stage of 696 miles to our Eastern Headquarters, Cairo, and it was during this period that some of us obtained a correct idea of what the real desert actually looks like. Also a desert sunset viewed from the air and the absolute pitchy blackness of the desert by night, these latter owing to difficulties in obtaining fuel supplies at Sollum, our last refuelling point 386 miles from Cairo. It is worthy of note here that our departure signal transmitted from the machine on leaving Sollum was picked up by the W.T. Station at Ramadi, 1,200 miles east of Sollum.

Cairo first appeared on the distant horizon as an indistinct glow, but shortly we were treated to an extraordinarily impressive view—Cairo from the air by night—a veritable fairyland of twinkling lights set in the blackness below. Without doubt it was Cairo and Christmas Eve, so having deposited the passengers, the trusty de Havilland "Hercules" was handed over to the Imperial Airways ground staff and tucked away for the night with its sister ship, both to be thoroughly inspected the following day. However, it proved that notwithstanding the most minute inspection nothing but minor adjustments were required, and this after their 2,900 miles flight through all conditions of weather. Compare this with the first by Mr. Orville Wright, whose machine remained off the ground exactly 12 seconds, and some idea of the advances made in aviation may be estimated.

Here three of our passengers, including our lady passenger (who, having thoroughly enjoyed her voyage vowed she would travel by no other means in future), left the liner. After a short but pleasant stay in Cairo the "Hercules," whose complement had been kept up to strength by three new passengers, booked in Cairo, left the ground again on its maiden voyage to Basra, at the head of the Persian Gulf, eleven hundred miles farther East.

A stop was made at Gaza in Palestine (40 minutes from Jerusalem), where the Imperial Airways have acquired a perfect aerodrome. This has been equipped with comfortable passenger accommodation and a large hangar for the machines. We next proceeded to Ramleh, where we remained for the night. Here it is worth remarking that our distinguished passenger, who before leaving Croydon had made a luncheon appointment in Jerusalem with the High Commissioner of Palestine, arrived at his destination in good time, having completed the journey by air in approximately 31 hours.

Leaving Ramleh at midday we passed over Jerusalem, 3,000 ft. above sea level, and a few minutes later crossed the Dead Sea, 1,400 ft. below sea level, and proceeded to Rutbah Wells, the only permanent water for many hundreds of miles of surrounding desert. Here we spent the night in a recently constructed fort—an isolated spot but full of life.

Rutbah is also a port of call for the Overland cars which ply between Baghdad and (*Continued on page* 365)

Exciting Days in the Pacific

Taking Alive Two-Ton Sea Elephants for a Zoo

By H. J. Shepstone, F.R.G.S.

THE San Diego Zoological Society, who now possess the second largest animal park in America, have added to their collection some magnificent living specimens of the Sea, or Seal, Elephant, so-called because the appendage on the nose of the male takes the form of a short trunk or proboscis.

The Sea Elephant is the largest of all the pinnipeds—not even excluding the walrus—running up to 16 ft. in length and turning the scale at over two tons.

The animals were taken from Guadalupe Island, a bleak, uninhabited height in the Pacific, some 21 miles in length and lying 140 miles off the coast of Southern California. The island belongs to Mexico, and from time immemorial has been the haunt of the Sea Elephants. At one time they congregated in the waters here in thousands, but were so ruthlessly slaughtered for their valuable oil that their extinction was threatened. Twenty years or so ago the numbers could be counted almost on the fingers of your hands. Then the Mexican Government, at the instigation of the naturalists of America, declared the island a reserve and the slaughter or taking of the Sea Elephant was forbidden. As a result the animals have increased considerably and the expedition sent out to bring some specimens to the Zoo at San Diego were astonished to find the herd to total about 450.

The expedition consisted mainly of some twenty officers and men of the United States Navy, who went "on their own" for the thrill of the thing and they were certainly well repaid.

Sections of strong knock-down cages made of heavy wire and timber were taken ashore in small boats and by dint of much manœvering "fences" were thrown around groups of the ungainly creatures, which lay about by scores, while even more remained in the water. Those particularly selected were segregated with difficulty, nobody being eager to approach within striking distance. These were a two-ton bull 14 ft. in length and two cows of 10 and 11 ft. respectively and weighing 1,500 pounds each. Though sluggish and slow of motion the animals were extremely hard to manage, bulk alone being a formidable drawback.

These elephant-trunked seals show scarcely any fear of human beings and make no effort to get away, the males even displaying some ferocity, hence it was a precarious task to noose the old bull and roll him into the improvised pen.

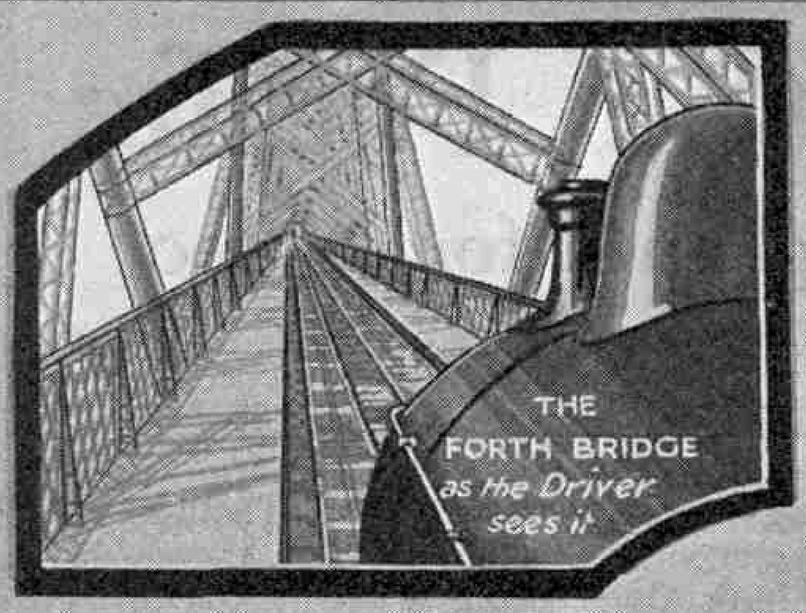
Sailors of the U.S. Navy capturing Sea Elephants for a Zoological Garden

A sea elephant can crack pebbles as large as goose eggs like nuts, and does so, apparently, for the sport of the thing, so his bite is to be avoided. The old bull resisted forcefully when the last segment was being lashed in position, tore into the gang generally, and severely lacerated one man's arm and shoulder. Others sustained severe bruises in the tussle.

Once the pen was afloat empty iron casks were fixed to it to act as buoys to keep the crate and its living occupant above the surface. Unfortunately these kept breaking away, with the result that the sea elephant went under too often and was nearly drowned before the transport was reached. Although a water denizen as well as a land animal, the sea elephant cannot remain very long under water without coming up to breathe. Hence, when the crate disappeared under the waves there was a rush to right it as soon as possible.

There was no crane on the vessel and the cumbersome, shifting burden had to be hoisted aboard with davits. Bad luck again attended the men's efforts. Twice the pen dropped back into the waves but each time it was quickly recovered and at last set right side up on the deck. The females were more easily captured and floated out to the ship, and were raised on board without serious difficulty.

As soon as the animals were placed on board, the ship started on her voyage back to the mainland, and in due course they reached the San Diego Zoo, where they are attracting many visitors. They are being fed on fresh fish and between them the trio consume 120 pounds a day.



Railway News OF THE MONTH

Locomotive Coal

In a recent lecture, Mr. R. Bell, assistant General Manager of the L.N.E.R., gave some interesting figures dealing with locomotive coal consumption.

Each year 13,500,000 tons of coal are used on British railways, a quantity that would only be sufficient to supply the United States railways for six or seven weeks. Approximately 125 lb. of coal are required to haul 1,000 tons of freight, excluding the locomotive, for a distance of one mile, but to achieve the same performance in America 159 lb. would be required, the difference being attributed to inferior fuel and heavier gradients.

To illustrate how an apparently minor achievement could result in large savings, it may be remembered that in 1924, when they were paying 22/5 per ton for coal, the L.N.E.R. informed their enginemen that, if every locomotive burned only 1 lb. of coal less over every mile covered, the company would use 75,000 tons less per annum and save £80,000.

Something of the heavy burden placed on the railways by the mining dispute last year was shown by the simple statement that in April last year the L.N.E.R. were paying 16/– per ton at pit-head, but after the commencement of the dispute, up to its end, the company bought over 1,500,000 tons of American and Silesian coal at an average cost of 38/– per ton, the price including loading into trucks at port of arrival.

* * * *

New Sidings

To speed up the coal traffic emanating from the collieries in the vicinity of the Carlton sidings on the Midland section of the L.M.S., the company are extending the accommodation at the sidings by the provision of fifteen new roads and further shunting and departure lines. A special road for disabled wagons will be provided, in addition to a 70 ft. engine turntable and two 60 ft. engine pits.

The extensions necessitate the filling in of approximately 200,000 cu. yds. of space and considerable progress has already been made with the work.

* * * *

Train Wireless Telephony in Germany

New special express trains, in which the passengers have the novelty of a telephone service at their command, have commenced to run non-stop over the 180 miles between Berlin and Hamburg. Each train carries a wireless set with an operator and at any point on the journey wireless communication can be established with receiving stations at both ends, and connections made there with the Berlin and Hamburg telephone services. Thus a passenger is able to telephone en route to any telephone subscriber in either of these cities. The charge made for messages varies according to the distance of the train from the city concerned.

Wireless telephony is being introduced also as an experiment on the Milan-Bologne and the Milan-Swiss Expresses.

L.M.S. Re-Numbered Locos

The following locos have recently been re-numbered:

Old No.	Name.	L.M.S. No.
"Experiment" Class		
165	"City of Lichfield"	5159
1990	"North Western"	5469
1994	"Scottish Chief"	5473
2627	"President Lincoln"	5510
"George the Fifth" Class		
681	"St. George"	5390
1513	"Otterhound"	5342
	"Queen Mary"	5329
"Precursor" Class		
1111	"Cerebus"	5200
1114	"Knowsley"	5217
1116	"Pandora"	5218
1117	"Vandal"	5194
"Renown" Class		
1931	"Agincourt"	5176
1970	"Good Hope"	5127
"Jumbo" Class		
1519	"Duchess"	5026
1173	"The Auditor"	5042
1170	"General"	5002
1168	"Cuckoo"	5102

Notes from Glasgow

L.N.E.R.—No. 9886 (N.B.R. class "K") recently rebuilt with superheater and standard Wakefield mechanical lubricator, and painted green, has been through Cowlairs shop again and is running fitted with a mechanical lubricator driven off the rear driving wheel. She has also been fitted with G.C.R. pattern screw reversing gear. She is temporarily shedded at Eastfield and was "watched" on Glasgow-Grangemouth slows for a week.

With a load of 245 tons (full), 6380, "*Evan Dhu*" did a good run on the 1 o'clock Edinburgh-Glasgow train recently, taking only 61 minutes against 65 booked. Working the same train with 270 tons, 6379, "*Baron of Bradwardine*," took only 62 minutes. The only stop is Haymarket, and the fastest non-stop run in the same direction is 61 minutes.

Engines working from Fort William into Glasgow just now are: 9256 "*Glen Douglas*" and G.N.R. 2–6–0 No. 4693. No. 9258 "*Glen Roy*" and 9298 "*Glen Shiel*" are both at Cowlairs just now—hence this mixed traffic engine. Working from Glasgow (Eastfield) the following have been noted:—9221 "*Glen Orchy*"; 9494 "*Glen Loy*"; 9496 "*Glen Moidart*"; and very occasionally, 9405 "*Glen Spean*" and 9307 "*Glen Nevis.*"

9875 "*Midlothian*" has been fitted with the boiler formerly belonging to 9903 "*Cock o' the North.*" This boiler is fitted with large Great Northern pattern snifting valve. Similar snifting valves are fitted to "Scott" class engines 9411 "*Dominie Sampson*" and 9414 "*Dugald Dalgetty,*" and 4–4–2 No. 9904 "*Holyrood*" (at present in Cowlairs shop).

Despite the number of "Directors" in Scotland, it is a good testimony for "Scotts" that the fastest run on the N.B.R. system should be allotted to a "Scott." The run is performed by a "Saturdays only" train from Polmont to Edinburgh, and the Eastfield engine recently seen on the turn was 9409 "*The Pirate.*"

Recent N.B.R. scrappings are 0–6–0 class "D," Nos. 1476, 9484, 9580; class "P" (1886) 0–4–4 T. 9586, and class "R" 0–6–0 T. 1328.

L.M.S.R.—M.R. standard 0–6–0 T. No. 7125 was recently seen on a local football special at Central Station.

There were recently in Central Station, quite close together, Deeleys 1135 (oil-burning) in from London, and 1140 (coal) on a train to Manchester.

C.R. Pickersgill 4–6–0 14653 is on the G.S.W.R. Section. There appears to be a shortage of passenger engines at Gourock and Drummond and small 0–6–0 No. 17387 was recently observed working regularly on Gourock-Glasgow (Central) passenger trains.

The London mails (6.35 p.m. ex Glasgow Central) have been handled by 4–4–0's 14364 (McIntosh non-suph.) and 14431 (suph. Dunalastair II.); during Christmas week the load was nine vans instead of six and Pickersgill 14476 was entrusted with this.

For a while during last December the 10 o'clocks from Edinburgh and Glasgow to London were being joined at Carstairs. For this purpose, two engines were put on at Glasgow, the pilot going through to Beattock Summit. It was, therefore, quite common to see two big engines, McIntosh 4–4–0 No. 14351 and Pickersgill 4–6–0 No. 14651, pulling out of Central Station on 200 tons—the load to Carstairs. This should have meant a very fast run to Carstairs, each engine pulling roughly its own weight.

Veteran Locomotives

Details of veteran locomotives are still coming to hand. Mr. G. F. Fox, of Hinckley, in the course of an interesting letter, gives details of twenty-seven 0–6–0 tender engines that were built between the years 1858 and 1872. These engines are of the "DX" class and are still working on various sections of the L.M.S.R. No. 3430 is at Crewe; 3130 at Bangor N.W.; 3402 at Bettws-y-Coed, while 3069 is stationed at Rugby.

Mr. Fox mentions also an old L.N.W. single (2–2–2) locomotive, No. 3020, "*Cornwall*," that will celebrate its 80th birthday in November next. This engine is attached to the Crewe Division and is still performing useful work in hauling the Chief Mechanical Engineer's saloon on tours of inspection. A point of special interest in connection with this engine is that its driving wheels are 8 ft. 6 in. in diameter, the largest in existence in this country or, probably, in the world.

* * *

A Forgotten French Express!

Throughout last summer one of the principal Paris-Milan expresses ran each day almost without passengers. Inadvertently the train was omitted from the timetables, and apparently many of the officials of the line were unaware of its existence! The train was timed to leave Paris for Milan at 10.30 p.m., 80 minutes after the slower and usually very much crowded Paris-Trieste train.

* * * *

Note on the Paris Railway Stations

One of our more fortunate readers, G. E. A. Clark, last year had the pleasure of spending a holiday in Paris and made a tour of the eight principal railway termini of that city. In a very interesting letter he records the following impressions, which are passed on for the benefit of those of our readers who also are interested in French railway matters:—

"I made a special point of visiting all the big termini in Paris. The Gare d'Orsay, the Paris terminus of the Paris-Orleans Railway, situated on the famous Quai d'Orsay overlooking the River Seine, impressed me most. The building is a fine piece of architecture and its extraordinary appearance is more like that of a museum than a station. Specially was I interested in the complete absence of that smoky smell so characteristic of most large termini. This is due to the employment of electric traction into Paris by the Paris-Orleans railway.

"The station is comparatively new, and the Gare d'Austerlitz, the earlier terminus, still is the finishing point of most of the steam-driven, long-distance traffic. The express trains are brought from Central France by "Pacific" type engines as far as the Gare d'Austerlitz and are then uncoupled and hauled to the Gare d'Orsay by electric locomotives of the 0–4–4–0 bogie type. I saw also a "Baltic" type engine in the station yard of the Gare d'Austerlitz.

"The Gare du Nord, which is the terminus of the Northern Railway, is also an imposing building, but here the smoky smell is very noticeable. The main line services from this station are hauled, almost without exception, by "Pacific" engines.

"The French State railways have three termini in Paris, the Gare St. Lazare, Gare des Invalides and the Gare Montparnasse. The latter two are comparatively small stations, but the Gare des Invalides resembles the Gare d'Orsay in that electric traction is employed into the station. Electric locos of the 0–4–4–0 bogie type haul the express trains to the outskirts of Paris, where steam locos are hitched on to continue the journey. The Gare St. Lazare is the largest of the Parisian termini and is a very imposing structure. It has over twenty platforms, and in addition to long distance traffic, running principally to the North-west of France, there is a vast quantity of suburban traffic. Huge "Pacific" engines are employed on the State railways to haul the long-distance trains."

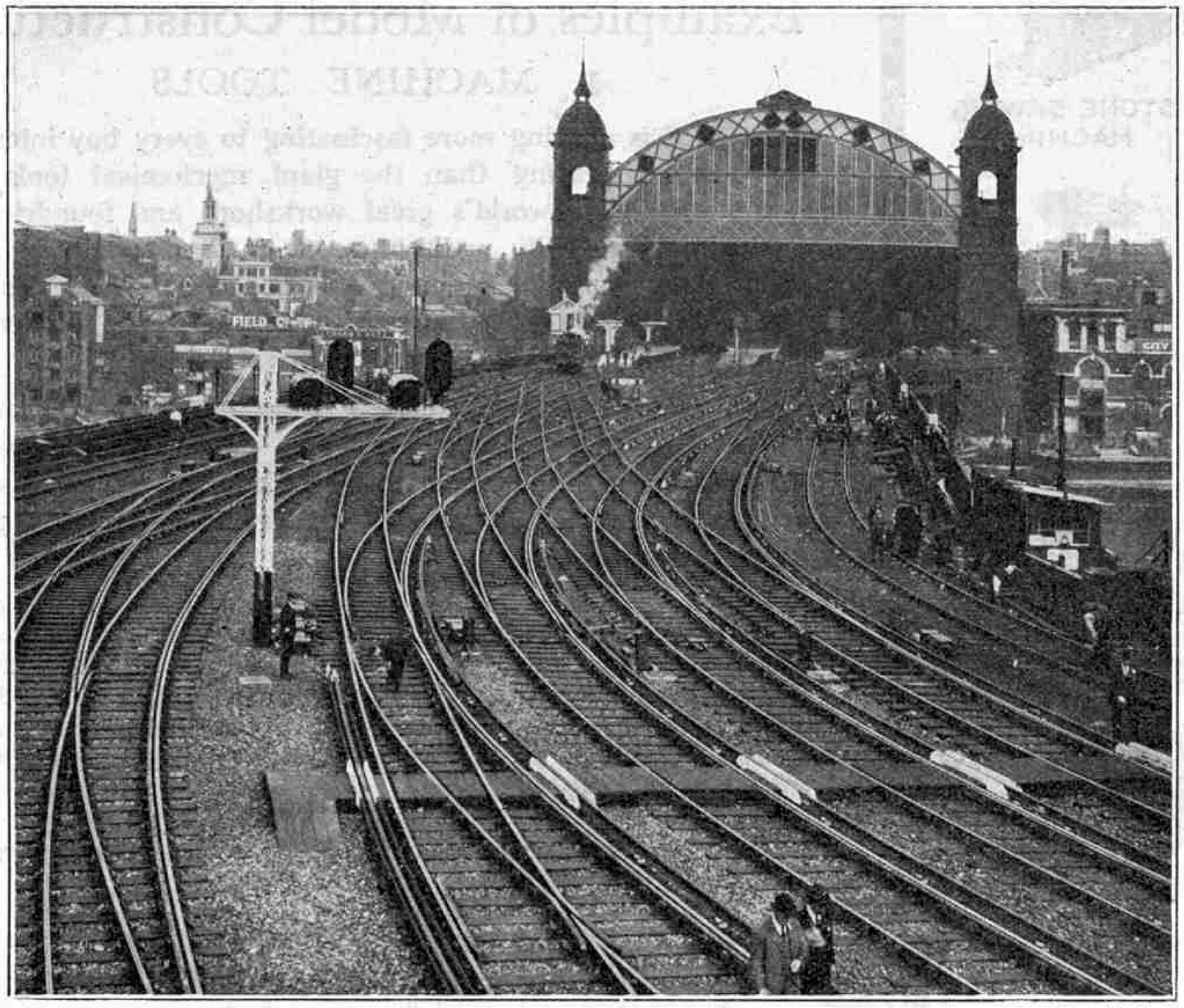


Photo courtesy] [*Southern Railway*

The approach to Cannon Street Station after it had been remodelled, as described in our article last month

New L.N.E.R. Marshalling Yard

The heavy increase in the goods and coal traffic passing over from the North and Midlands to the South and Eastern counties has necessitated the construction of a new marshalling yard on the L.N.E.R. at a point just north of March, adjacent to the existing yard at Whiteman. A new tranship shed is to be constructed and the estimated cost of the complete scheme is £300,000.

* * *

Railway Snow-Melting Device

Fortunately for railway operations in this country, the quantity of snow that falls is rarely sufficient to cause danger to working, but in some parts of America snowfalls are so extensive that not only do snow ploughs have to be used, but special means of clearing switches, turnouts and other equipment are essential.

On the Boston and Maine Railroad therehas been placed in service a new type of snow-melting device, consisting of a pipe line attached to the steam dome of the locomotive and leading to a point below the engine pilot. The pipe line is fitted with nine nozzles each ½ in. in diameter and the steam supply is regulated by a valve connected with the engine cab. The engine is run over the points at a speed of two or three miles an hour while steam is directed through the nozzles on to the snow-covered surface.

* * * *

L.N.E.R. Expresses Named

On 1st January titles were conferred upon the following L.N.E.R. expresses. These are, of course, in addition to the famous "*Flying Scotsman*" which has left King's Cross at 10 a.m. regularly for some 65 years. The time given for the various expresses are those of departure from King's Cross.

The 11.10 a.m. "*West Riding Pullman*"; 11.20 a.m. "*Harrogate-Edinburgh Pullman*"; 11.50 a.m. (Summer) "*Scarborough Flier*"; 7.25 p.m. (Summer) "*Highlander*"; 7.30 p.m. (Summer) "*Aberdonian*"; 7.40 p.m. (Winter) "*Aberdonian*"; 10.25 p.m. "*Night Scotsman.*"

* * * *

L.N.E.R. "Pacific" No. 2553, which up till recently bore the name "*Manna*," has been renamed "*Prince of Wales*," to commemorate its inspection by His Royal Highness during his recent visit to the L.N.E.R. Doncaster sheds.

THE NEW MECCANO

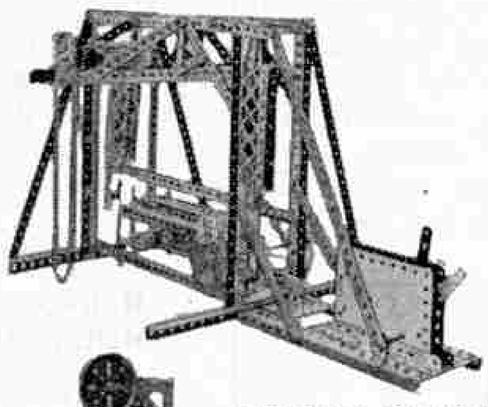
Examples of Model Construction:

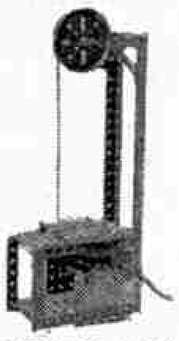
1. MACHINE TOOLS

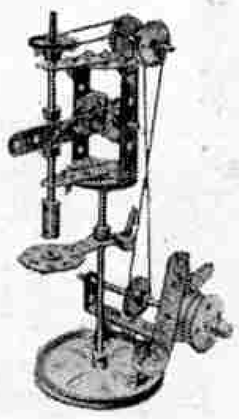
THERE is nothing more fascinating to every boy interested in engineering than the giant mechanical tools with which the world's great workshops and foundries are equipped. The daily work of some of these great machines would have employed hundreds of men a generation or so ago; their enormous strength has brought into existence the dynamo, steam engine, locomotive, and battleship.

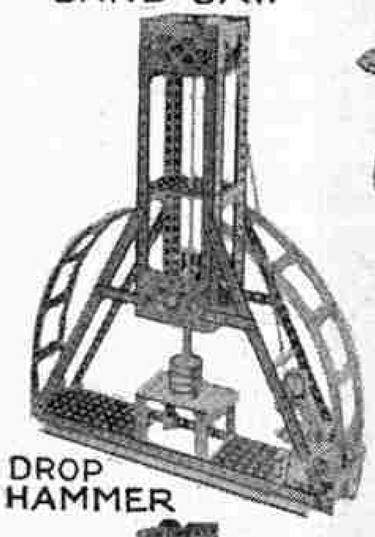
It is interesting to surmise what our earliest ancestors would have thought of a man who could deliver blows of sufficient strength to forge a steel ingot into a liner's crankshaft; yet with a touch of the finger, the operator of a modern power hammer controls a force equal to fifty or sixty foot-tons!

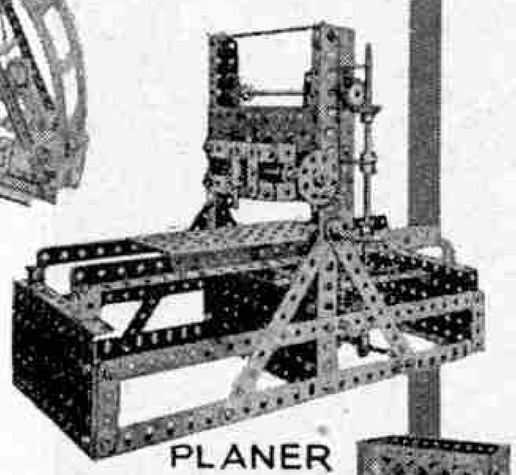
We illustrate a selection of Meccano models, representative of this important branch of engineering. Meccano Machine Tools are not only miniature reproductions of the real thing; they may be *worked* like the real machines. By adding a fretsaw or hacksaw blade to the Sawing Machines, small pieces of wood may be cut through; similarly, by inserting a small twist-drill in the Drilling Machines, holes may be bored through strips of wood, and so on.


STONE SAWING MACHINE

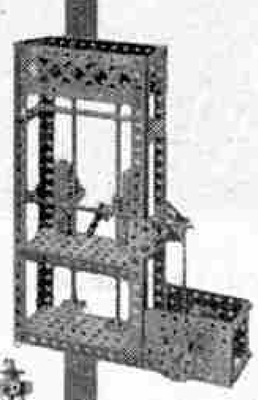

BAND SAW

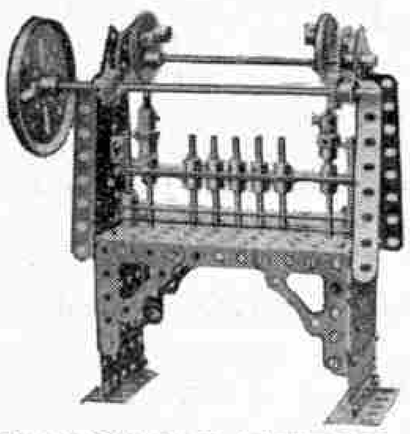

POWER DRILL

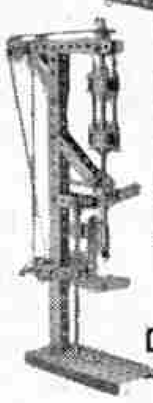

DROP HAMMER

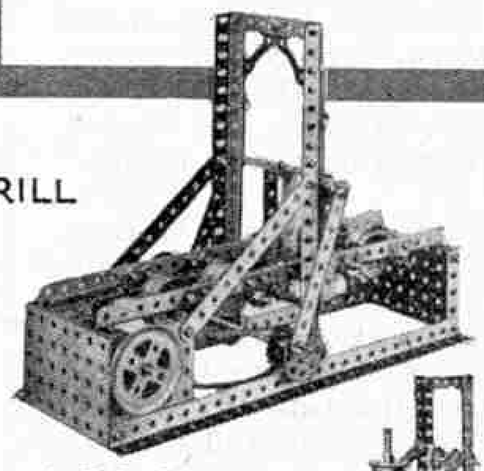

PLANER

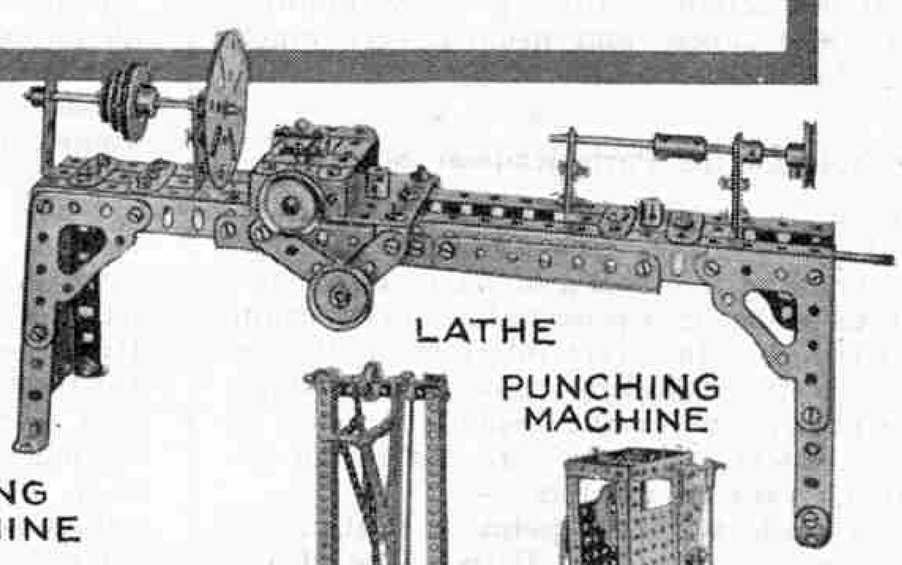
PILE DRIVER

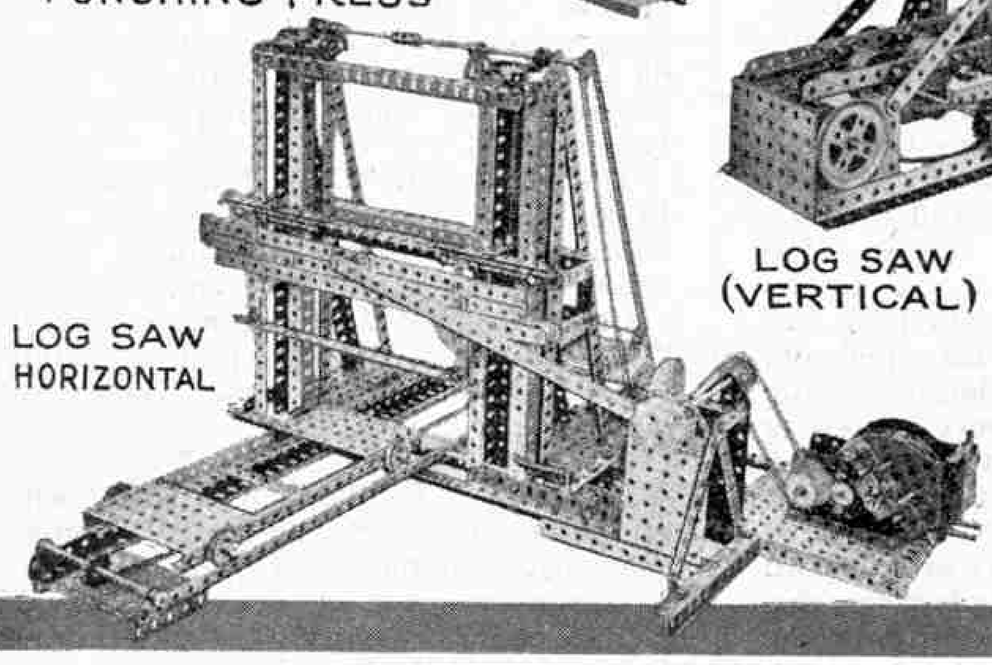

TRIP HAMMER

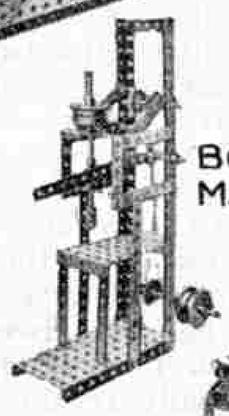

PUNCHING PRESS

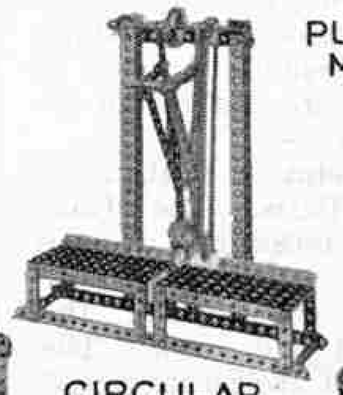

DRILL


LOG SAW (VERTICAL)


LATHE


LOG SAW HORIZONTAL


BORING MACHINE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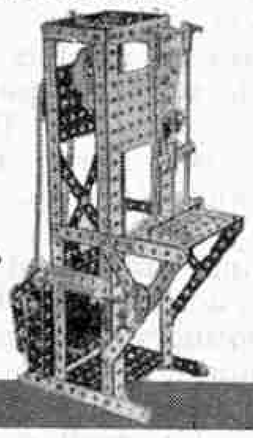

PUNCHING MACHINE

CIRCULAR SAW

MECCANO PRICES

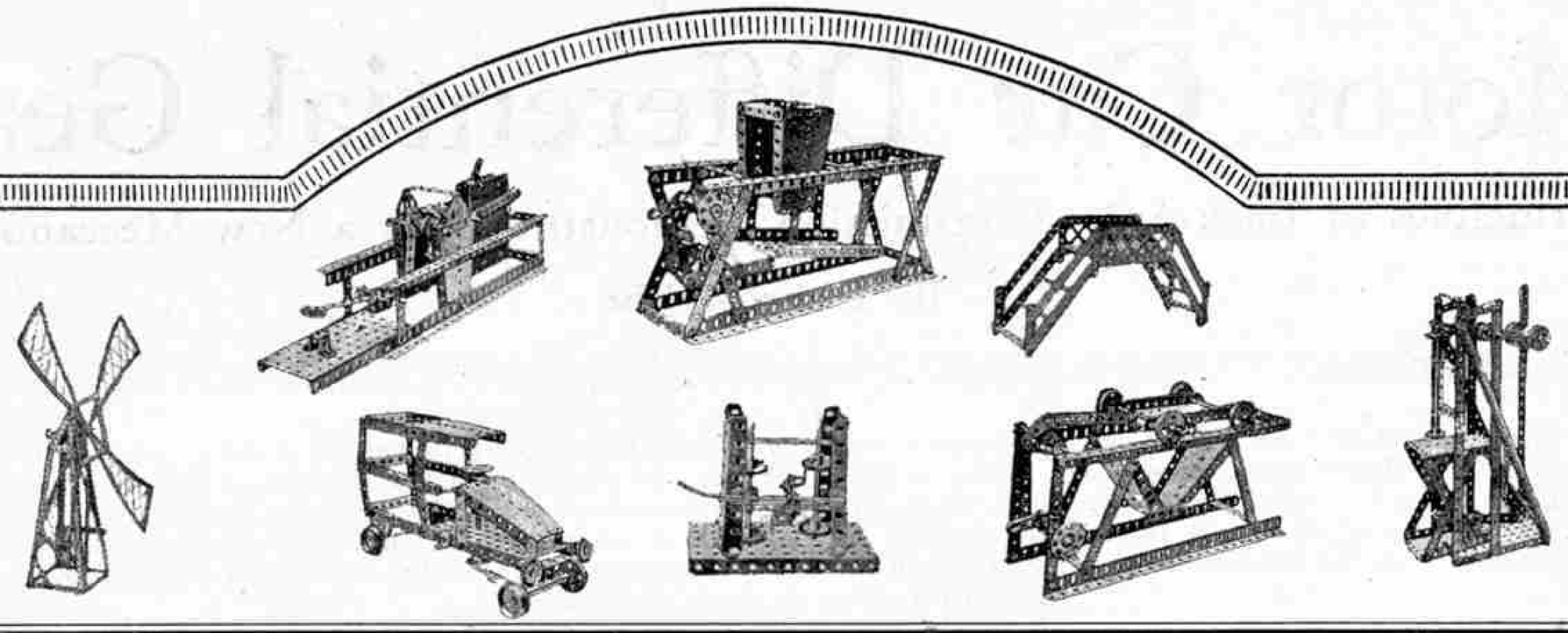
COMPLETE OUTFITS

No. 00	3/6
No. 0	5/–
No. 1	8/6
No. 2	15/–
No. 3	22/6
No. 4	40/–
No. 5 (in well-made carton)	55/–
No. 5 (in superior oak cabinet with lock and key)	85/–
No. 6 (in well-made carton)	105/–
No. 6 (in superior oak cabinet with lock and key)	140/–
No. 7 (in superior oak cabinet with lock and key)	370/–

ACCESSORY OUTFITS

No. 00a	1/6
No. 0a	4/–
No. 1a	7/6
No. 2a	8/6
No. 3a	18/6
No. 4a	15/–
No. 5a (in well-made carton)	50/–
No. 5a (in superior oak cabinet with lock and key)	80/–
No. 6a (in superior oak cabinet with lock and key)	210/–

MECCANO LTD., Binns Road, LIVERPOOL



A New "No. 2 Outfit"

Model-Building Competition

Readers who have not yet sent in their entries for the splendid new "No. 2 Outfit" Competition that was announced in last month's *"M.M."* still have sufficient time to do so before the contest closes.

This competition is the third of the 1927 "Outfit" series. The prizes are offered for models built entirely from a No. 2 Meccano Outfit and models comprising parts that do not appear in that Outfit will be disqualified. It is not necessary to use all the parts contained in the Outfit. Those boys who possess larger sets need not abstain from competing, for their entries are eligible providing they use only parts that may be found in the No. 2 Outfit. A list of these is given in the Instruction Manuals; they were also shown in last month's *"M.M."*

Four Different Sections

Prizes will be awarded for the models that the judges decide to be the best received, after due consideration has been given to the originality of thought and constructive skill displayed in every entry. Models possessing points of exceptional interest will be described in the Magazine and if suitable they will also be included in forthcoming Instruction Manuals.

An interesting feature of the contest lies in the fact that all competitors will have at their disposal an equal number of parts. Any type of model may be submitted provided that it is the competitor's own unaided work, both in design and construction.

Entries will be divided into the following sections: Section A, for competitors over 16 years of age. Section B, for competitors under 16 and over 12 years of age. Section C, for competitors under 12 years of age. Section D, for competitors residing outside Great Britain.

LIST OF PRIZES

Prizes will be awarded for the best entries FROM EACH SECTION as follows:—

FIRST PRIZE: Meccano products to the value of £3-3s.

SECOND PRIZE: Meccano products to the value of £2-2s.

THIRD PRIZE: Meccano products to the value of £1-1s.

SIX PRIZES, each consisting of Meccano products to the value of 10/6.

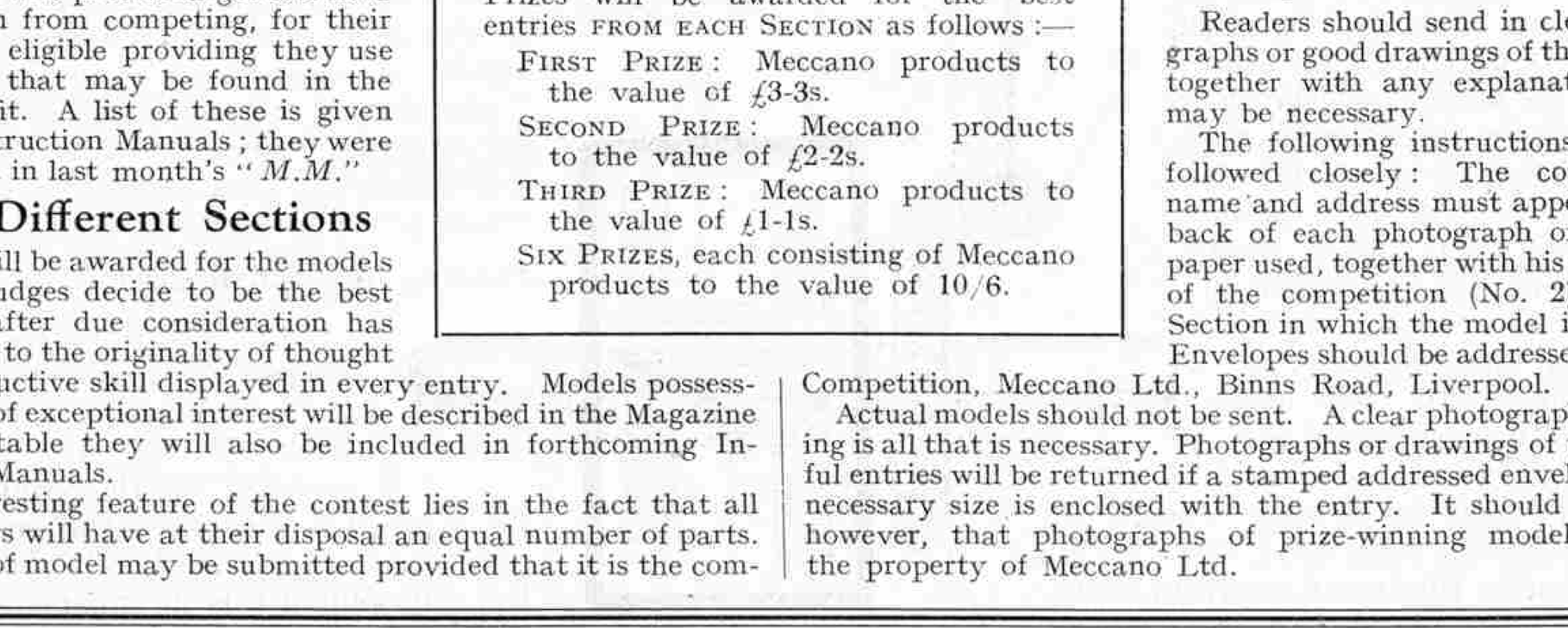
CLOSING DATE for Sections A, B, and C: 30th April. Section D: 31st August, 1927.

Important Instructions

Readers should send in clear photographs or good drawings of their models together with any explanations that may be necessary.

The following instructions must be followed closely: The competitor's name and address must appear on the back of each photograph or sheet of paper used, together with his age, name of the competition (No. 2) and the Section in which the model is entered. Envelopes should be addressed "No. 2" Competition, Meccano Ltd., Binns Road, Liverpool.

Actual models should not be sent. A clear photograph or drawing is all that is necessary. Photographs or drawings of unsuccessful entries will be returned if a stamped addressed envelope of the necessary size is enclosed with the entry. It should be noted, however, that photographs of prize-winning models become the property of Meccano Ltd.



Motor Car Differential Gear

The Principles of Back-Axle Transmission Demonstrated by a New Meccano Model

By Edgar Wright

In the February "M.M." our contributor explained the mechanical principles involved in steering a motor car, and described a Meccano model of Ackermann steering gear. Below he deals with rear axle transmission, and describes a Meccano "spur-gear" differential that may be used as an alternative to the differential gear at present fitted to the Meccano motor chassis (Model No. 701). The type of differential represented in the latter model is more common in actual practice, but a good deal of useful information will be obtained from the construction of the gear shown in the accompanying article, and many readers may prefer to use this new form in their Meccano motor cars.

IN the article entitled "Steering a Motor Car," which appeared in the February issue of the *"M.M."* it was explained that when a car travels in a curved or circular path, the two front road wheels must each describe an arc struck from the centre of the circle or portion of a circle in which the car moves, and the outer wheel must naturally follow an arc of greater radius than the wheel that is nearer to the centre. This will be clear on reference to Fig. 3, which is reproduced from the February issue for the benefit of those readers who are unable to refer back to that number.

The drawing is intended to represent a car turning a corner and in doing so the wheels must describe an arc or portion of a circle whose centre point is shown at A. It is obvious that the radius AC of the outer wheel (that is its distance from the centre A) is greater than the radius AB of the inner wheel. Since this is the case, it will be clear that the outer or farthermost road wheel must traverse a greater distance or revolve a greater number of times than the inner wheel.

The difference in speed thus set up between the two wheels is not important in the case of the front wheels, for they are both free to turn on their individual axles; but it is obvious that since the rear or driving wheels are similarly placed in regard to the central point A, the same rule must apply to them. To state this more plainly, the rear wheels should rotate at different speeds when the car moves in a curve, otherwise slip will take place between the tyres and the road surface, which would result, at least in the heavier types of cars, in damage to the tyres and in more or less serious inconvenience to the steering. But both these wheels must be driven constantly from the engine, and each must receive an equal amount of driving power. Therefore it is necessary to incorporate in the back axle, or in a supplementary shaft connected at each end to one of the rear wheels by means of chain or belt drive, some device that will transmit the power evenly to the wheels and at the same time allow for the difference in speed that arises immediately the car deviates to any extent from the straight.

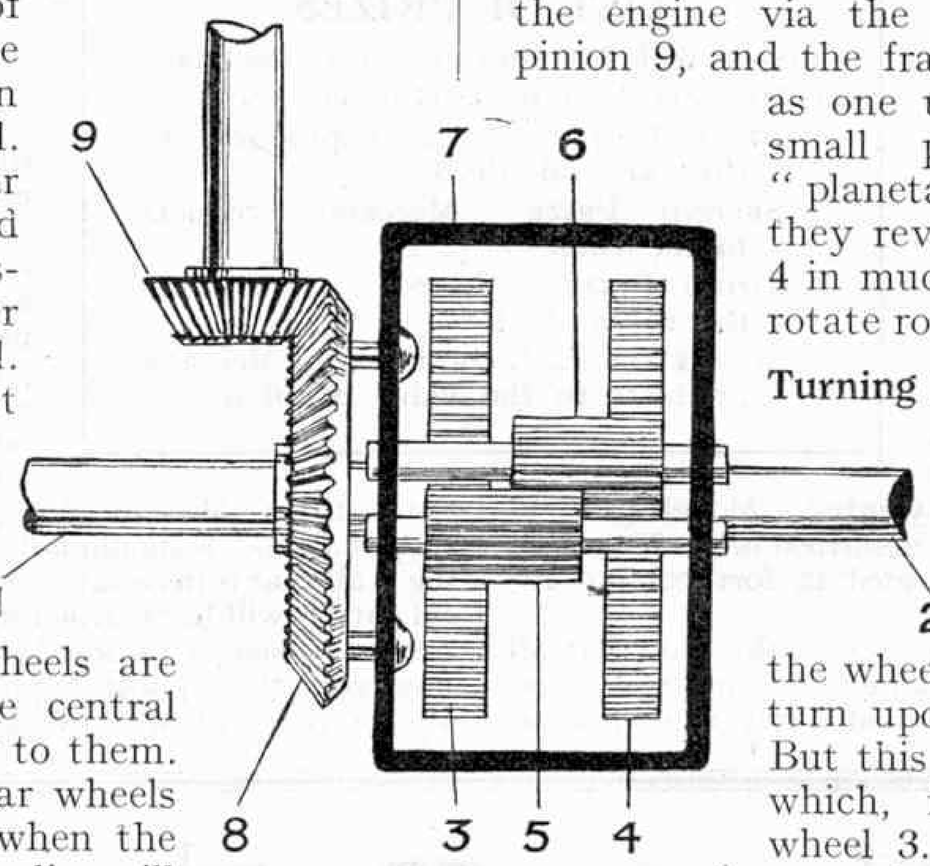


Fig. 1

Principle of Differential Gear

The mechanism that fulfils these functions is known as a "differential" or balance gear. Its operation may be followed from studying Fig. 1, which is intended to illustrate the principle of the apparatus only.

The back axle of the car is composed of two separate sections 1 and 2, each of which carries at its outer end one of the road wheels. The shaft 1 is rigid with the gear wheel 3 and shaft 2 is secured in a similar wheel 4. The small pinions 5 and 6 are mounted so as to be in constant engagement with each other. Pinion 5 also engages with the gear wheel 3 and pinion 6 with the wheel 4. The spindles on which the pinions are mounted are journalled in a frame or cage 7 rigidly fastened to a large crown bevel 8, which is free on the shaft 1. The crown wheel 8 receives the driving power imparted by the engine via the propeller shaft and small bevel pinion 9, and the frame 7 and pinions 5 and 6 rotate as one unit with the crown wheel. The small pinions are sometimes termed "planetary" wheels, for the reason that they revolve round the gear wheels 3 and 4 in much the same manner as the planets rotate round the sun.

Turning in a Small Circle

Now suppose that for some reason the road wheel on shaft 2 is immovable and that the frame 7 and the bevel 8 are rotated by the engine. Since the wheel 4 is stationary the pinion 6 must turn upon its spindle as it rolls round 4. But this pinion 6 is in engagement with 5, which, in turn, meshes with the gear wheel 3. Therefore the wheel 3 must be rotated from the action of the pinion 6 as it rolls round 4, thereby driving the other road wheel on shaft 1. The whole power of the engine is now absorbed in the rotation of this road wheel, which, if resting upon the ground, will cause the car to turn in a small circle.

It must be understood that rotation of the pinions about their own spindles can only take place when the resistance on the wheels 3 and 4 differs, for when the pinions rotate one of the gear wheels must turn faster than the other. If the shafts 1 and 2 are equally difficult to turn there is no inducement for the pinions to commence to rotate, so the road wheels are driven at equal speeds and the car travels in a straight line.

When the car turns a corner the speed of the inner road wheel tends to fall off, the resistance increases on the gear wheel connected to it, and the pinions

commence to rotate, thereby driving the outer wheel at a greater speed. The difference in the speed of the two wheels varies of course, with the degree of the curve described by the car.

The New Meccano Differential Gear

The type of differential shown in Fig. 1 makes use of ordinary spur gearing, but in actual practice bevel gearing is more often employed, the gear wheels 3 and 4 being replaced by two large bevels and the pair of pinions 5 and 6 by a small bevel pinion which meshes with the two larger bevels. In both types the planetary pinions are reproduced several times to obtain added strength and smoothness of operation. Two, three or even four pairs of spur pinions are used in the one case and two, three, or four bevel pinions in the other. The bevel type of differential is well represented in Meccano by the gear used in the back axle of the existing model motor chassis (see Standard Mechanism No. 251). The model differential about to be described is based on the straight-toothed or spur gear type, which has not hitherto been reproduced in Meccano.

Fig. 2 is a general view of the Meccano "spur" differential, and the diagrams in Figs. 4 and 5 (see next page) show respectively the side and end elevations of the mechanism. The following details should help to make the construction of the model quite clear :—

The Axle Rods 1 and 2 (Fig. 2) form the shafts carrying the road wheels of the vehicle and are separate one from the other, as in Fig. 1. The Rod 1 is secured in the boss of a 57-teeth Gear Wheel 3 and a similar wheel 4 is fixed to the Rod 2. The extreme end of the latter Rod is inserted in the centre of the Gear Wheel 3, which thus serves as an additional support, but it should be noted that the Rod is free to turn independently of this wheel.

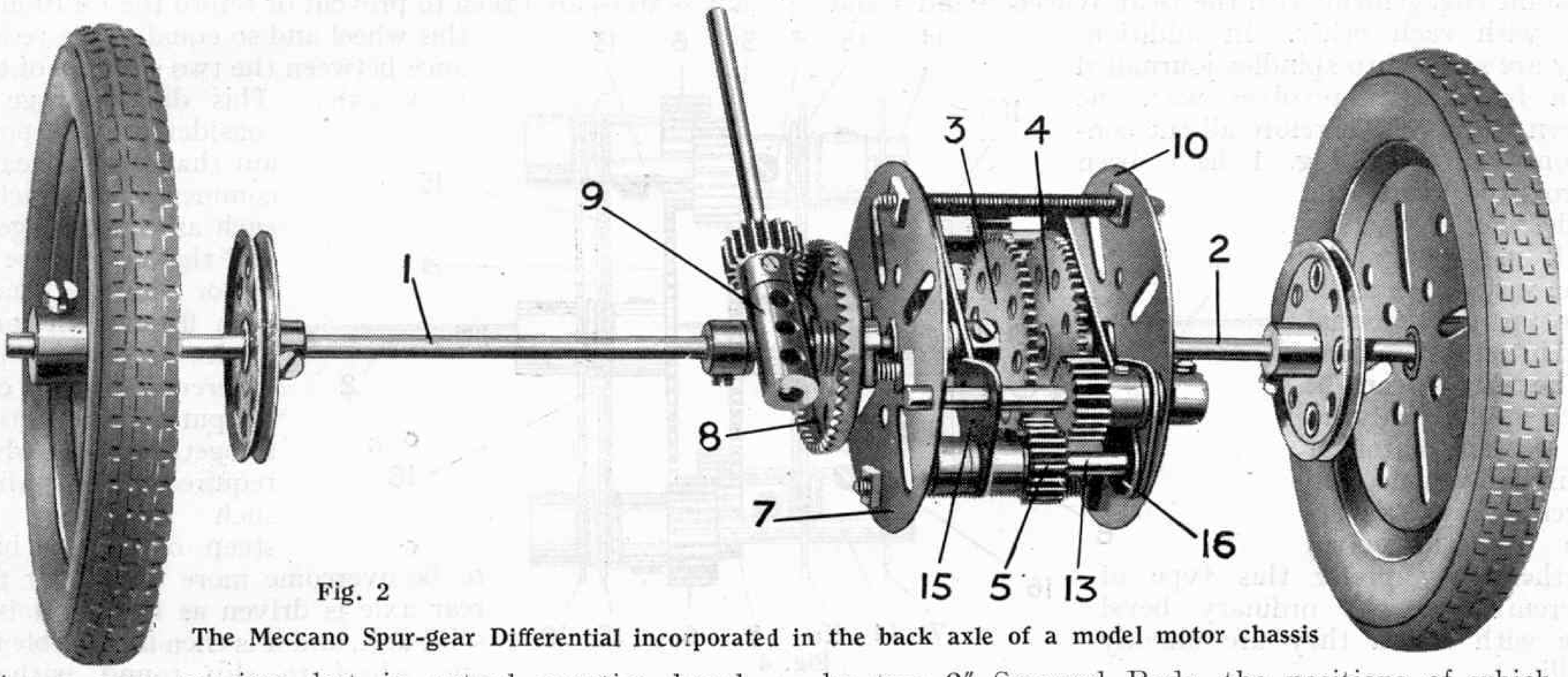


Fig. 2

The Meccano Spur-gear Differential incorporated in the back axle of a model motor chassis

The rear end of the propeller shaft is journalled in the Coupling 9, which is free on the Rod 1, and a 19-teeth Pinion on the propeller shaft drives the $1\frac{1}{2}$" Contrate Wheel 8. The latter is secured by two $\frac{1}{2}$" Bolts to a Face Plate 7 which, together with another Face Plate 10, forms a revolving frame corresponding to 7 in Fig 1. The Face Plates are bolted together by two 2" Screwed Rods, the positions of which are indicated at 11 and 12 in Fig. 5. A portion of one of these Rods is also shown at 11 in Fig. 4, the remainder of the rod having been omitted for the sake of clearness. The Face Plates are free to turn about the axles 1 and 2.

The Planetary Pinions

The revolving frame carries two pairs of planetary wheels, each pair consisting of $\frac{1}{2}$" Pinions 5 and 6 secured respectively to a $1\frac{1}{2}$" Rod 13 and a 2" Rod 14 (see Fig. 4). The Rods 14 are journalled in opposite holes in the Face Plates and each Rod carries two 1" Triangular Plates 15, a Washer being placed on each side of the Plate 15 that adjoins the Pinion 6. The Rods 13 also pass through holes in these Triangular Plates and in addition each Rod 13 passes through the end holes in two $2\frac{1}{2}$" Strips 16, the centre holes of which engage the axles 1 and 2. Each Strip 16 is spaced away from its adjoining Face Plate by means of two Washers.

The Rods 13 do not engage in any way with the Face Plates, but the arrangement of the $2\frac{1}{2}$" Strips and Triangular Plates provides ample bearings in which they may turn ; the Triangular Plates ensure proper alignment between the Rods 13 and 14, while the $2\frac{1}{2}$" Strips maintain the Rods 13 at the correct distance from the axles 1 and 2. The arrangement of the Rods 13 and 14 and their bearings will be followed more easily perhaps on reference to Fig. 5, which is an end elevation of the Face Plate 10 and adjacent parts.

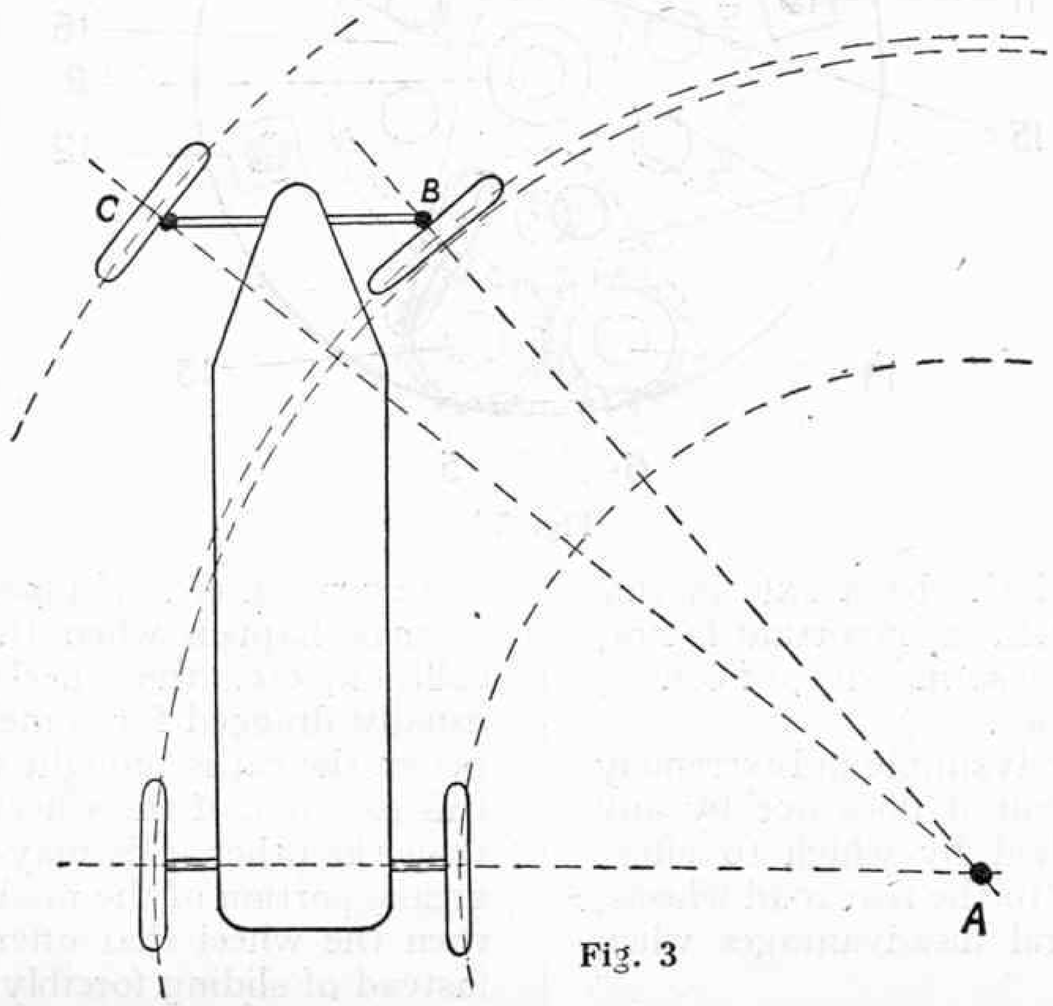


Fig. 3

It may be noted that the differential movement may be obtained with only one pair of Pinions 5 and 6, but the second pair has been added with the object of increasing the strength and reliability of the device as well as to balance the stresses set up by the various elements revolving about the back axle.

Now it will be seen that the Pinions 5 and 6 are in constant engagement with the Gear Wheels 3 and 4 and also with each other. In addition, they are secured to spindles journalled in a frame that revolves with the driven wheel 8. Therefore all the conditions shown in Fig. 1 have been reproduced and the model will be found to work in exactly the same way as the spur-gear type of differential used in actual practice.

The model can be fitted quite easily to any Meccano motor car or similar vehicle, and Meccano boys can decide for themselves whether they prefer this type of differential or the ordinary bevel type with which they are already familiar.

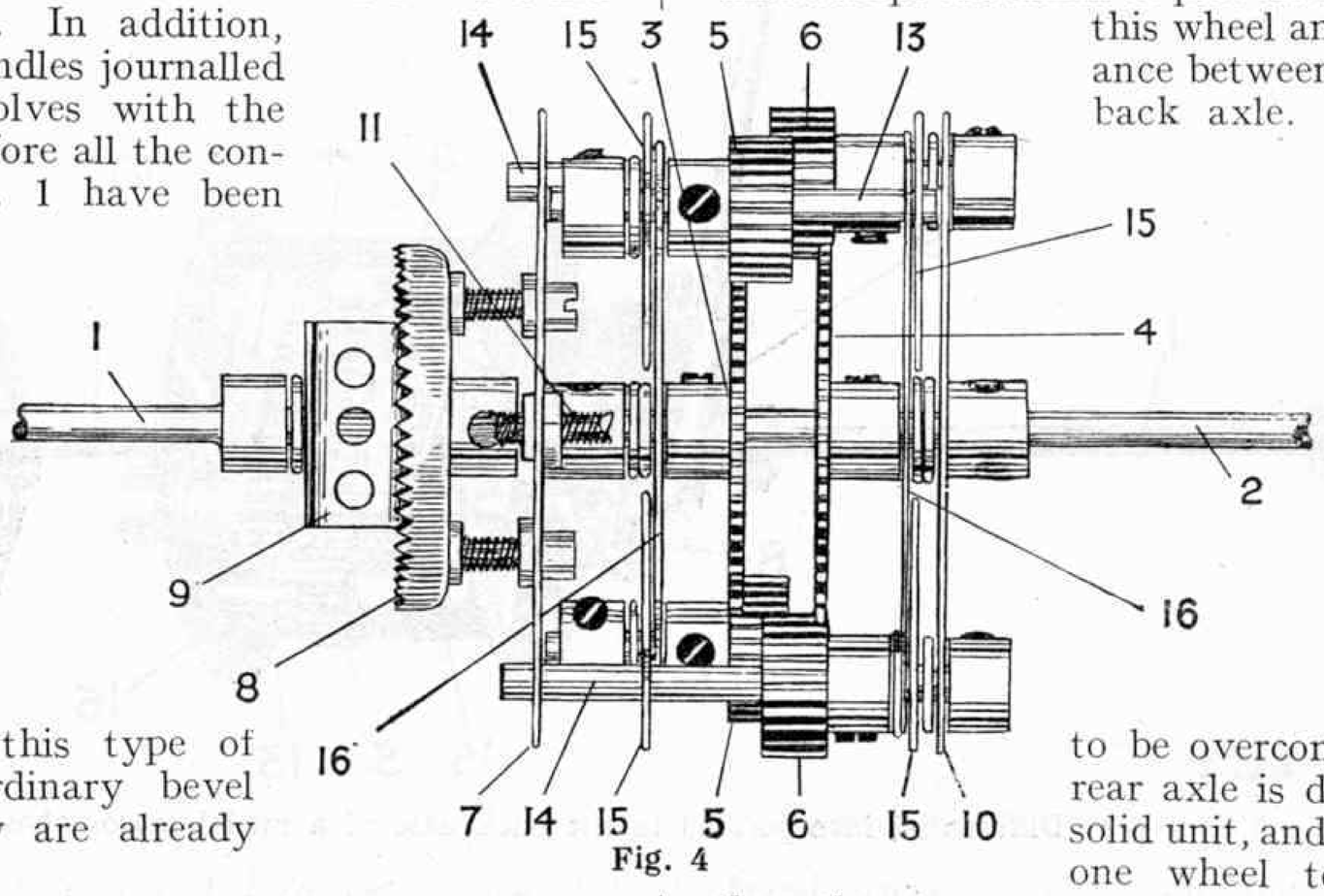


Fig. 4

Disadvantages of the Differential

It has already been indicated that the differential is not always embodied in the back axle. In the heavier types of motor lorry, for example, it is carried usually in the chassis frame, in which case each of the driving shafts is fitted at its outer end with a small sprocket by means of which the drive is led to the rear wheels through chain gearing. In a layout of this kind the rear axle is described as "dead," because the road wheels run freely on its ends without the axle itself rotating; the axle serves merely as a distance piece and to support the weight of the vehicle. A "live" axle is one that embodies the differential and actually transmits the drive to the wheels.

The chief advantage of the "dead" axle method lies in the fact that it reduces the unsprung weight (i.e. that of the back axle) to a minimum, but the objections to its application to ordinary touring cars are, principally, the noise created by the chain drive and the excessive wear and tear to which the chains are subjected. Moreover, the weight of the back axle in this class of car does not constitute such an important factor, since its construction is not nearly so massive, of course, as in the big commercial vehicles.

The differential is a comparatively simple and extremely ingenious piece of mechanism, but it does not by any means represent the ideal method by which to effect smooth transmission of the drive to the rear road wheels, for it is found to possess several disadvantages when put into practice.

For example, it makes no provision for the application of increased power to the particular driving wheel that requires it most. Suppose one rear wheel of a motor car becomes firmly stuck in mud while the other rests on a smooth or greasy surface over which the tyre slips easily. The power of the engine is wasted in turning the free wheel at great speed, and the car will remain fast unless steps are taken to prevent or retard the rotation of this wheel and so equalise the resistance between the two sections of the back axle. This disadvantage is considered so important that certain heavy commercial vehicles, such as steam wagons and the larger type of motor lorries, have been fitted with some device with which the differential gear can be put out of action altogether as and when required. This enables such difficulties as steep or greasy hills to be overcome more easily, for the rear axle is driven as though it is a solid unit, and it is then impossible for one wheel to slip round without the other.

Again, if the brake on one of the rear wheels is more efficient or acts slightly in advance of that on the other wheel, the entire power of the engine is directed momentarily on that wheel which receives the least braking effect.

A Remarkable Spectacle

A very curious result for which the differential is responsible may often be seen in any busy street. This is the spectacle presented by a car that, having been braked suddenly, skids along for a few feet with one rear wheel revolving very rapidly *backward,* or in the opposite direction to that in which the car is moving. This strange effect is produced in cars that are equipped with a brake on the propeller shaft behind the gear box, and is caused by violent application of this brake, as will be understood from the following:—

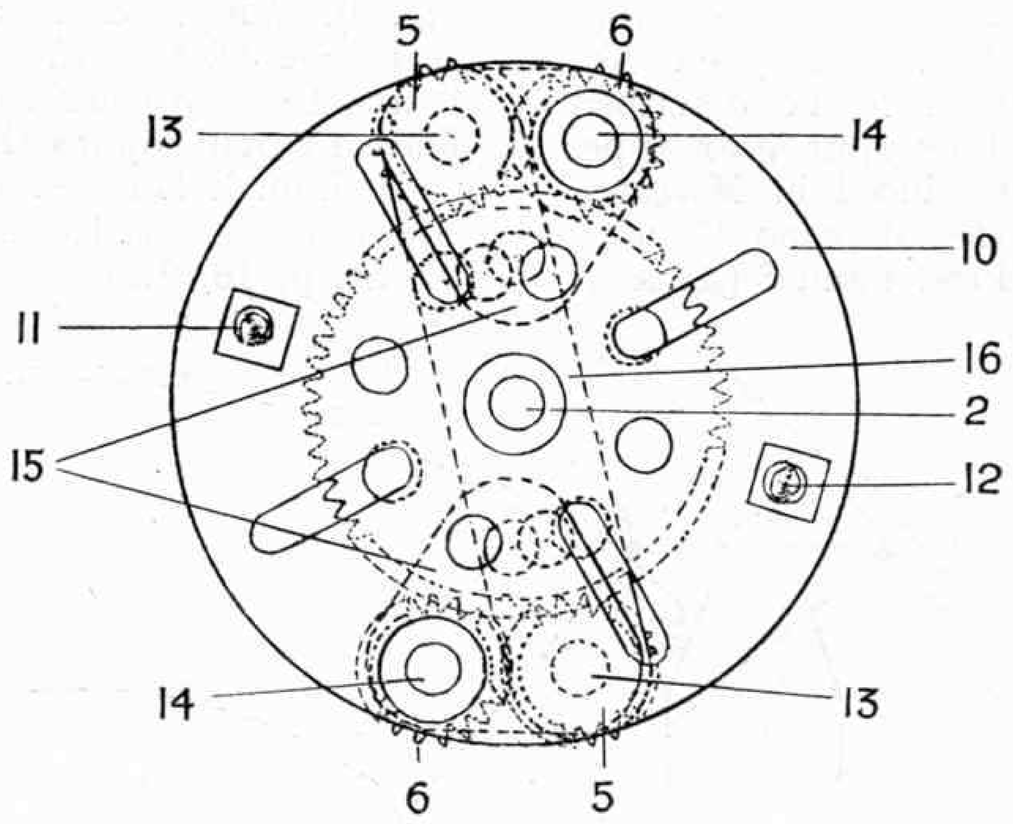


Fig. 5

The sudden stoppage of the propeller shaft and its pinion (corresponding to 9 in Fig. 1) arrests the rotation of the crown bevel 8 and its subsidiary frame 7 carrying the planetary wheels. If a motor car is braked very suddenly, as may happen when the driver attempts to avoid a collision, etc., the wheels, though securely locked, are usually dragged for some little distance along the road before the car is brought finally to rest. But suppose in this case one of the wheels grips the road more securely than the other (this may easily happen on account of a greasy portion of the road surface or a badly worn tyre); then the wheel that offers most resistance will revolve instead of sliding forcibly over the

(*Continued on page* 357)

Gormorants at Home

The Lonely Island of St. Kilda

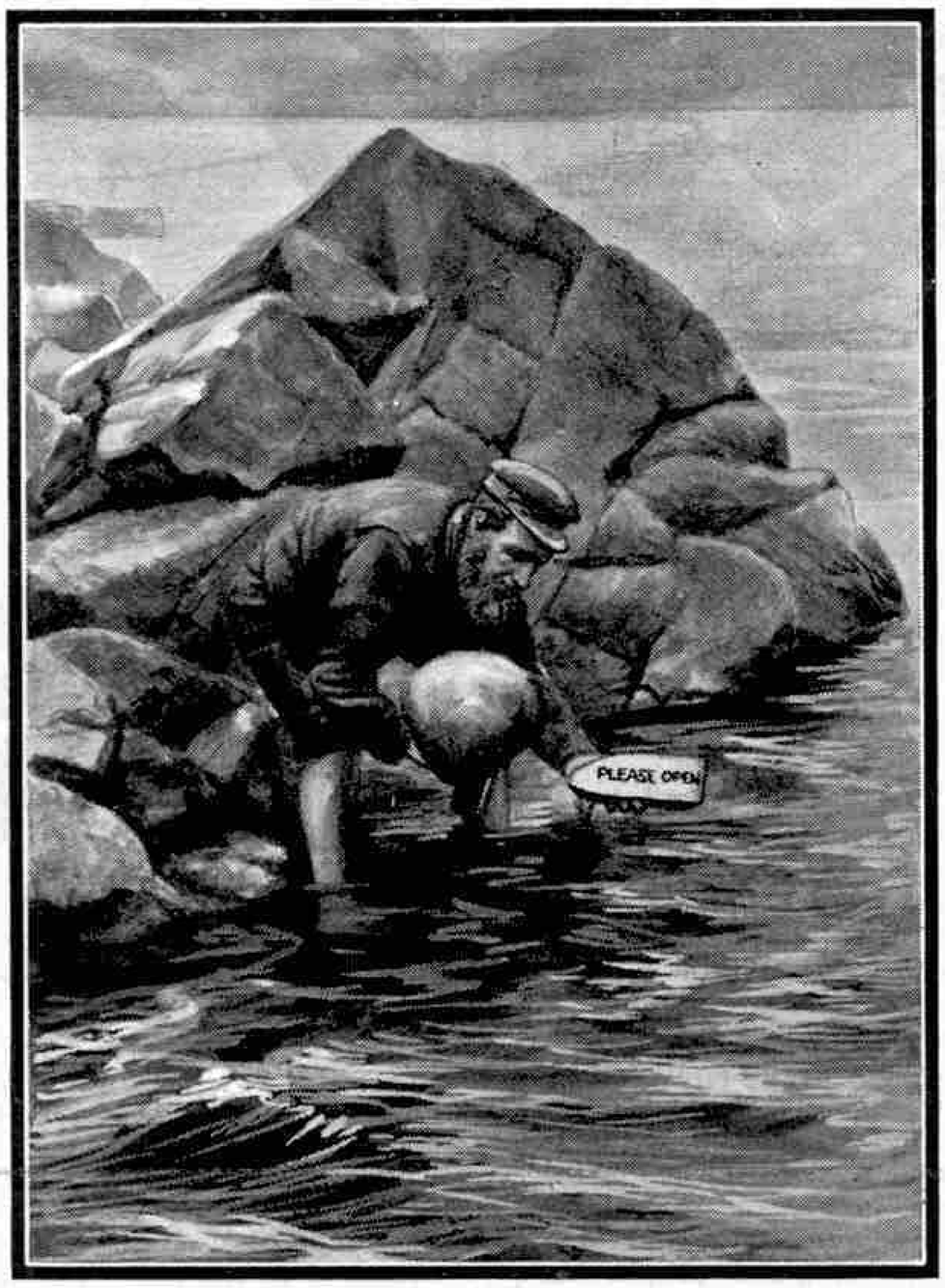
An Outpost of the British Isles, exposed to the fury of the Atlantic

Guillemots on Cliff

A SHORT time ago references were made in the newspapers to a feared shortage of food on the island of St. Kilda. These references have drawn attention to an outpost of the British Islands, the existence of which is often forgotten.

St. Kilda is the largest islet of a group of the Outer Hebrides off the west coast of Scotland. It lies 40 miles west of North Uist and is exposed to the full fury of the Atlantic. The island measures about three miles from east to west and two miles from north to south, and except at the one landing place on the south-east side it is bounded by cliffs rising sheer out of deep water and attaining at one point a height of 1,220 ft. above the sea.

How this lonely island first came to be inhabited is uncertain, but there is a tradition that the inhabitants of the Hebridean islands Harris and Uist both desired to secure St. Kilda and decided to settle the matter by a race. Accordingly each island provided a rowing boat with a picked crew, and the long struggle began. There was so little difference in strength, skill and endurance between the two crews that they arrived at St. Kilda practically together, the Uist boat being very slightly ahead. The chief of the Harris men, seeing that there was a possibility of the Uist men landing first, chopped off his left hand and threw it ashore, thus securing the island!



Primitive "Mailboat" being launched from Village Bay, St. Kilda

It appears to be probable that St. Kilda was inhabited as early as a thousand years ago, as various implements and the remains of earthenware vessels that have been found there are almost certainly of Viking origin.

One of the most striking features of St. Kilda is its enormous bird population and indeed it is a veritable paradise for the ornithologist. Mr. Richard Kearton, the well-known naturalist, visited the island in 1896, and gives a fascinating account of his stay there in his book "*With Nature and a Camera.*" Describing an excursion from St. Kilda to its small neighbour Borrera, Mr. Kearton says:—

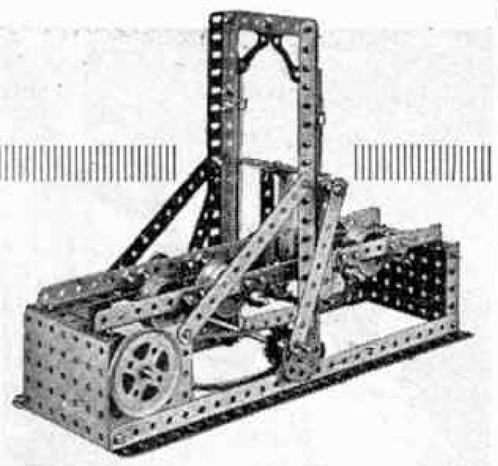
"As we neared the island the scene became simply magnificent. The air above and around us was thickly peopled with thousands upon thousands of Gannets of different ages, as could easily be seen from the wonderful variation in the colour of their plumage. . . . As far as the eye could see small objects, the sea was covered in every direction by a vast throng of Puffins, Guillemots and Razorbills, many of which gazed in bewildered astonishment at us until the bows of the boat got quite close to them, when they dived with the swiftness and silence of thought and were gone. . . .

"To our left was Stack Lee, a gigantic pillar of rock rising about three hundred feet out of the ocean. Its sloping upper parts and every available ledge and corner were positively white with Solan Geese sitting on their nests. Such a snow-like mass do these birds present, that we were told on a fine day the Stack may be distinctly seen from Long Island—a distance of 40 miles."

Of another small island, named Soa, Mr. Kearton writes: "Puffins simply swarmed in the air above it, on the rocks and earth of which it is composed, and dotted the sea all round as far as the power of a pair of good field-glasses could make them out. Those on the wing twirled round and round in a great cloud that perceptibly interfered with the light of day as it passed over us. The swish of their wings made a continuous buzz."

For many years the St. Kildans have adopted a very interesting means of communicating with the mainland. A solid piece of wood is roughly cut into the shape of a boat having a hollow space sufficiently large to contain a small tin or bottle to form a watertight receptacle. In this are placed the letters, together with a note asking any person who picks up the little

(Continued on page 349)



Suggestions Section

Edited by "Spanner"

(79)—Radius Indicator for Meccano Cranes

(G. S. Marsh, Thornton-le-Fylde, Blackpool)

MOST Meccano boys probably know that the load capacity of a crane varies according to the particular angle of the jib, for the nearer the latter approaches the horizontal position the greater will be the strains upon it in proportion to the load.

This statement may be verified quite easily by applying the principle of the triangle of forces which, it will be remembered, is summarised on page 202 of the complete Manual of Instructions as follows: "If three forces meet at a point and are in equilibrium, and we know one of the forces, we may determine the other two by drawing a triangle, making each side parallel to the direction of one of the forces, and comparing the dimensions of the three sides." It will be found that these dimensions are in the same proportion as the three forces. For example, supposing the side corresponding to the known force is four units in length and the others are eight and ten units, and supposing the known force is four tons, then we know that the other two forces must equal eight and ten tons respectively.

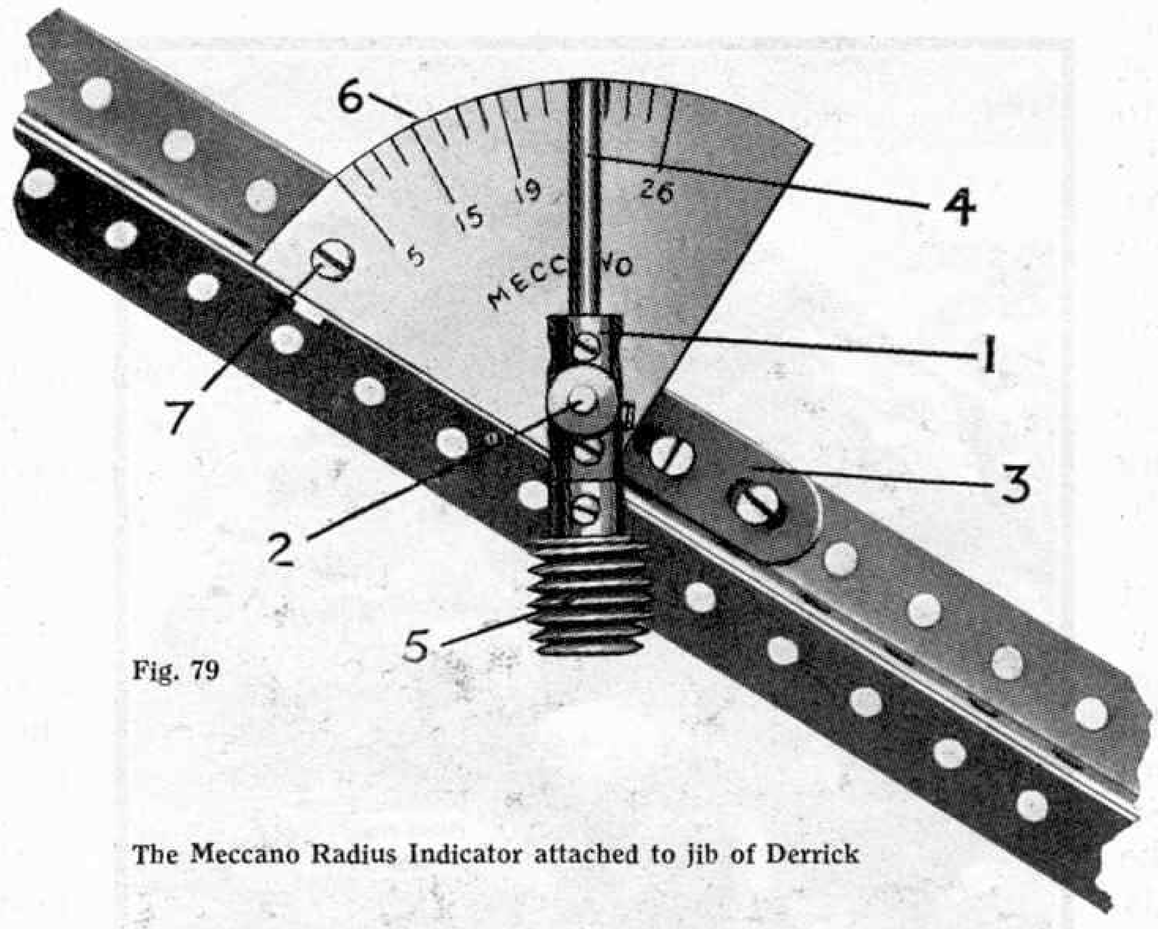


Fig. 79

The Meccano Radius Indicator attached to jib of Derrick

Determining the Strength of a Crane

In the case of a crane the three forces are (a) the load suspended from the head of the jib, (b) the tension member, or tie, which supports the jib (in luffing cranes the operating cable or chains, etc., with which the jib is raised or lowered correspond to the tie members), and (c) the jib, which acts as a strut to withstand the compressive force exerted by the combination of (a) and (b). All three forces meet in the head of the jib and counterbalance each other; that is to say, they are in equilibrium.

By drawing one or two triangles and showing the side that is parallel to the jib in a different position in each triangle, it will be found that the strains that the crane structure must withstand increase as the jib approaches more nearly the horizontal position, as stated in our opening paragraph. It should be noted that the disposition and proportion of the strains or forces vary according to the particular type of crane.

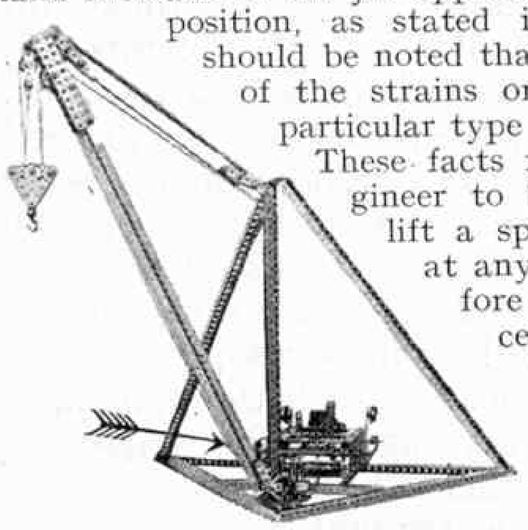


Fig. 79a. Showing position of indicator in the Stiff Leg Derrick

These facts render it impossible for an engineer to build a luffing crane that will lift a specified load with equal facility at any position of the jib. He therefore designs his crane to lift a certain load at a certain radius, the radius being measured from the point about which the crane pivots to a point immediately beneath the load hook. Thus a swivelling and luffing crane that is described in the specification as capable of raising with safety a load of 20 tons at a radius of 20 feet may be able to lift only 10 tons or thereabouts at a radius of 35 feet.

Therefore, when lifting a heavy load with a crane of this type, care must be taken to see that the jib is at the proper angle to cope with that load. A margin of safety is allowed, of course, for each of the various positions of the jib, but if this margin is overstepped, excessive strains may be set up in the structure and machinery. It is to minimise the possibility of such a mistake being made that a radius indicator is fitted to the majority of luffing cranes. A glance at this indicator tells the operator the position of the jib and the maximum load that he can handle safely without increasing the angle of the jib. Hence the device not only saves time but also obviates a considerable risk of accidents.

A radius indicator may easily be constructed in Meccano and fitted to any model crane that is equipped with luffing mechanism, and a device of this kind will increase the realism and interest of a model to a remarkable extent. The indicator illustrated on this page was designed by George S. Marsh, of Thornton-le-Fylde, Blackpool.

Construction of the Meccano Indicator

Fig. 79 shows the indicator attached to the side of the jib in the Meccano Stiff Leg Derrick (Model No. 709) and the actual position of the device in relation to the remainder of the model is indicated more clearly by the arrow in Fig. 79a.

The Coupling 1 is free to turn about the 1½" Axle Rod 2, which is gripped in the boss of a Crank 3 bolted to the upturned flanges of the jib girders. It carries in its upper end a further 1½" Rod 4 and in its lower end a 1" Rod on which is secured the Worm 5. The weight of the latter serves to keep the Rod 4 always vertical, no matter in what position the jib is placed. A dial 6, shaped from a piece of stout cardboard, is bolted at 7 to an Angle Bracket attached to the jib. The Rod 2 passes through a hole in the dial and carries two or three Washers to space the Coupling 1 away from the card so that the Worm 4 will clear the edges of the girders forming the jib.

The dial moves with the crane, and the Rod 4, remaining vertical, acts as a pointer and registers the variations in the angle of the jib. It is a simple matter to set the jib in different positions, and to mark on the card the radius of the area covered by the load hook for each position of the pointer.

Our contributor points out that an indicator of this type proves very useful when loading, say, a stationary lorry or railway wagon, for the jib-angle required to bring the load directly over the vehicle having once been noted, each succeeding load can be swung round and luffed immediately to the correct position. In addition, interesting experiments may be made by means of the indicator and the load capacity and efficiency of various types of Meccano cranes tested.

(80)—A Meccano Vernier Condenser

Fig. 80 shows an efficient vernier condenser that may be constructed very easily from Meccano parts. This simple model provides extremely fine tuning facilities and those of our readers who are radio enthusiasts should find it extremely useful.

Referring to the illustration, it will be seen that the condenser plates 1 and 2 are formed from two Face Plates. Plate 1 is immovable and is secured by its set-screw to a 1″ Axle Rod held in the Collar 3. The set-screw of the latter has been removed and replaced by a 2″ Threaded Rod, which is fixed in a vertical position in the boss of a Threaded Crank 4.

This Crank 4 is secured by means of two Meccano 6 B.A. Bolts to the $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate forming the base, and is insulated therefrom by Insulating Bushes and Washers placed upon the bolts above and below the Crank. Another Insulating Bush is placed on each bolt below the base plate before the nuts are finally tightened into position. It will be noticed that the terminal 5 is attached to a $1\frac{1}{2}''$ Strip forming an extension of the Crank 4; the object of this extension is to prevent the connecting wires from touching the base plate.

The movable condenser plate 2 is secured to a 2″ Threaded Rod, which engages the longitudinal bore of the Threaded Boss 6. The Boss is supported on another vertical Rod secured in a second Threaded Crank bolted to and insulated from the base plate in the same manner as the Crank 4. The set-screw 7 inserted in the Threaded Boss 6 may be used to reduce play in the horizontal Threaded Rod. The handle of the condenser is formed by a Threaded Pin secured to the face of a Bush Wheel, and another terminal 8 is provided for connecting purposes.

The Meccano Threaded Rods are cut with thirty-two threads to the inch; hence one complete revolution of the hand-wheel effects an alteration equal to 1/32″ in the distance between the Condenser plates.

In operation it will be found that an insulated handle must be used in place of the Threaded Pin unless the terminal 8 of the movable plate 2 can be connected to earth or to the positive terminal of the H.T. battery. If a circuit of this description is used the insulation of the plate and its support becomes unnecessary and the fibre washers may be removed without any disadvantage.

Alternative Designs

Other types of Meccano condensers will probably suggest themselves to the reader. A popular type is that which employs a movable plate arranged between two fixed plates in such a way that its whole area may be gradually inserted between the fixed plates or withdrawn as desired. The fixed plates are connected together electrically, but the bearings of the movable plate must be insulated, of course. The latter plate should be connected to the earth or to the positive side of the H.T. battery.

It should be noted that where electrical contact is required between Meccano parts, the enamelled pieces should not be used.

The following readers have submitted interesting suggestions concerning the construction of Meccano condensers or vernier coil-holders on similar principles to those described above, and each will receive a special Certificate of Merit: J. E. Harris, Clacton-on-Sea; L. S. Owen, London, N.20; W. Halliwell, Marsden, near Huddersfield; L. Stevenson, Karachi, India; and C. A. Croughton, London, S.E.23.

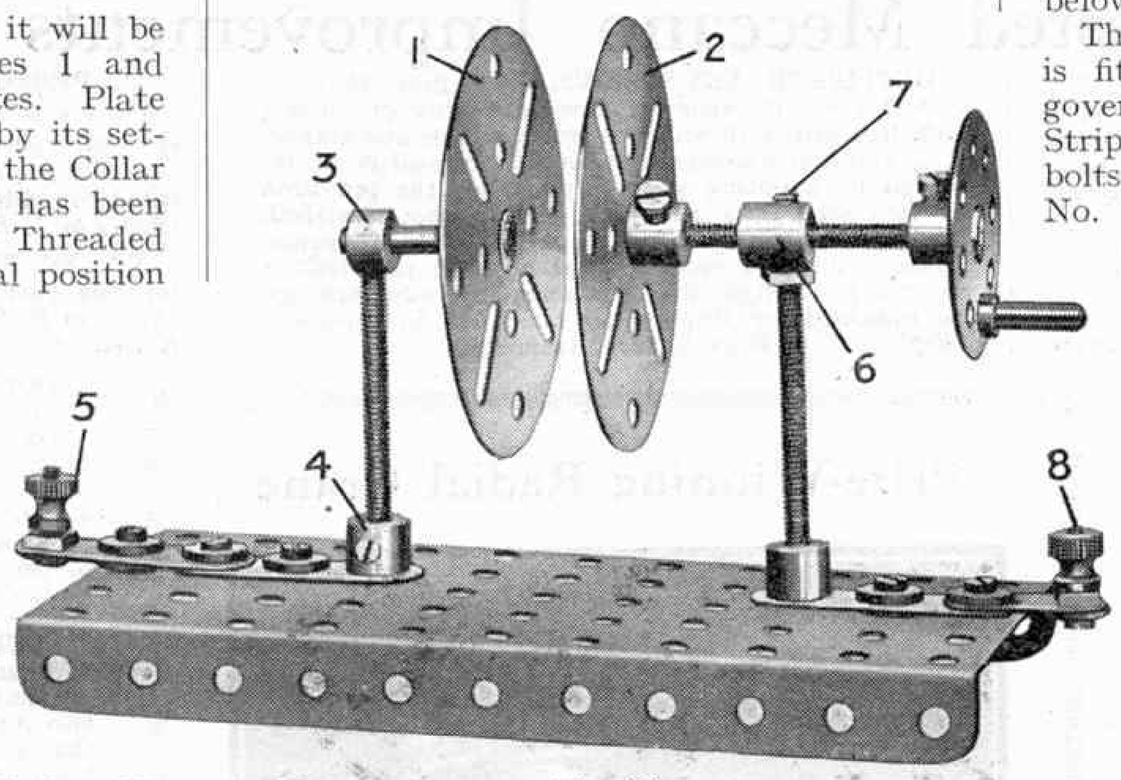


Fig. 80

(81)—Non-Slip Belt Pulley

P. Short (Wallington) points out that an efficient non-slipping continuous cord drive may be obtained in any Meccano model by substituting for each driving pulley two Bevel Wheels placed face to face, so that the sloping edges of their teeth form a V-groove to receive the cord. An alternative and more economical method is to use a Bush Wheel in place of one of the Bevel Wheels.

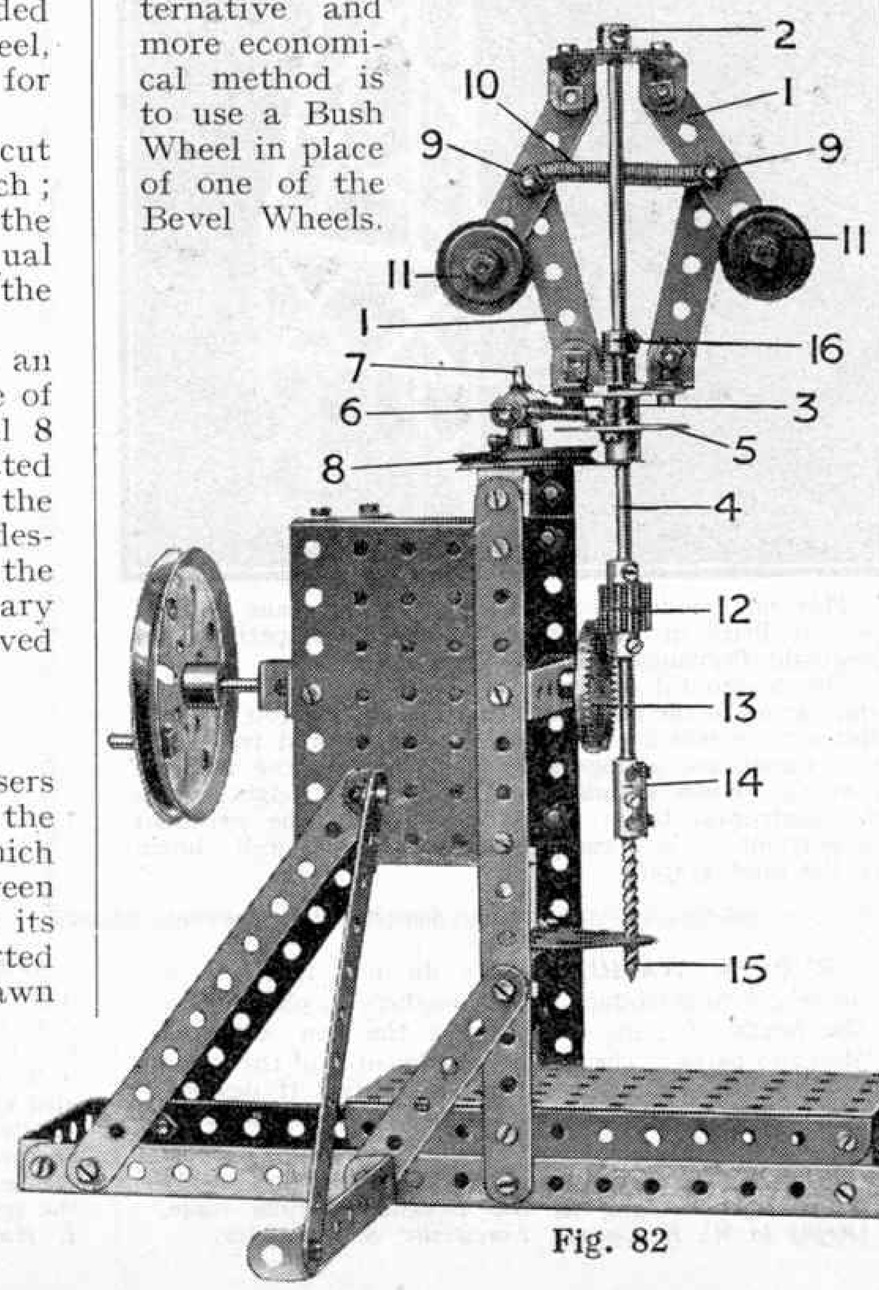


Fig. 82

(82)—Self-Acting Drilling Machine

(G. K. Hooper, Liscard, Wallasey)

Fig. 82 shows an interesting Meccano model of a type of drilling machine that automatically adjusts the pressure of the drill and removes the tool from the work when the speed of the machine drops below a certain limit.

The vertical drill shaft 4 (an 8″ Axle Rod) is fitted at the top with a centrifugal governor, consisting of two pairs of $2\frac{1}{2}''$ Strips 1 pivotally attached by means of bolts and nuts (see Standard Mechanism No. 263) to Angle Brackets bolted to two Bush Wheels 2 and 3.

The upper Bush Wheel 2 is secured to the vertical Rod, but the wheel 3 is without a set-screw. The latter wheel is secured by means of two $\frac{3}{4}''$ Bolts to another Bush Wheel 5, which also is free on the Rod 4. These Bush Wheels 3 and 5 are prevented from moving vertically by means of two $\frac{3}{4}''$ Bolts inserted in place of the set-screws in two Collars 6, which are held fast on 1″ Axle Rods inserted in opposite ends of a Coupling that is secured by its centre transverse hole to a third 1″ Rod 7 gripped in the boss of a $1\frac{1}{2}''$ Pulley Wheel 8. The Pulley 8 is bolted rigidly to a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip at the top of the framework.

The two pairs of $2\frac{1}{2}''$ Strips 1 are pivotally attached to one another by means of the bolts 9. These bolts also serve to secure a Spring 10 that tends to draw inward the weights 11, each of which consists of 1″ fixed and 1″ loose Pulley Wheels secured together by means of a $\frac{3}{4}''$ Bolt.

Centrifugal Force

The vertical Rod 4 carries two $\frac{1}{2}''$ Pinions 12 butted together in the manner shown. These pinions are in constant engagement with the $1\frac{1}{2}''$ Contrate Wheel 13 secured to the shaft of the operating handle. The Coupling 14 serves as a chuck to receive the drill 15, which, of course, is not a Meccano part.

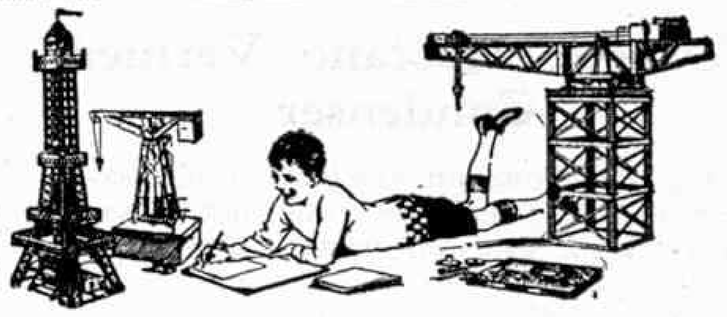
As the speed of the shaft 4 increases the weights 11 tend to fly outward, owing to the centrifugal force set up by their rapid rotation, and since the wheels 3 and 5 are unable to rise, the Bush Wheel 2 commences to descend, thereby pushing the Rod 4 downward and applying the drill to the work. In doing this, however, it must extend the tension spring 10; hence, immediately the speed of the shaft 4 drops, the spring reasserts itself and raises the Bush Wheel 2 to its former position.

The Collar 16 serves to prevent the Rod 4 descending too far. Care should be taken to see that the teeth of the Pinions 12 coincide exactly, for they must remain in engagement with the Contrate Wheel 13 throughout the vertical movement of the drill-shaft.

Parts Required:

2	of No.	1B	1	of No.	13A	3	of No.	24
4	„ „	2	1	„ „	15A	2	„ „	26
2	„ „	4	3	„ „	18B	1	„ „	28
5	„ „	5	1	„ „	19B	62	„ „	37
2	„ „	8	1	„ „	21	1	„ „	43
2	„ „	10	2	„ „	22	1	„ „	45
6	„ „	12	2	„ „	22A	6	„ „	48A
						2	„ „	48B
						1	„ „	52
						2	„ „	53
						4	„ „	59
						2	„ „	63
						6	„ „	111
						1	„ „	115
						2	„ „	126A

In Reply



In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Suggestions submitted for consideration in this section must be written on separate sheets of paper and the name and address of the sender must appear on each sheet used.

Suggested Meccano Improvements

MECCANO DYNAMO.—Your suggestions concerning the introduction of a dynamo to supply current for the Meccano Motors, Hornby Lamp Standards, etc., are scarcely practicable, we fear, for quite a considerable power plant would be required to drive a dynamo that would produce the necessary amount of current. (*Reply to O. Sanders, Melton Mowbray, and Edward Day, London, W.*12).

DIARIES FOR MECCANO BOYS.—The proposal regarding the publication of special pocket diaries for Meccano boys has been reviewed in these columns already but we were unable to do anything in connection with it for 1927. The question will receive further attention, however. (*Reply to Leonard Wall, Birmingham, and D. Miller, Higher Tranmere, Birkenhead*).

MOTOR BOGIES FOR MECCANO MODELS.—We note your suggestions to the effect that the motor bogies of Hornby electric and clockwork locos should be punched with the standard Meccano equidistant holes and sold separately, so that they may be used when it is required to construct a Meccano model to run on Gauge 0 rails. Few models, however, could be built around these motors in a realistic fashion, and we consider it much more satisfactory to employ the Meccano Electric or Clockwork Motor as the means of propulsion. (*Reply to W. H. Bett, Birmingham*).

SUBJECTS FOR MODEL-BUILDING.—We have read your remarks concerning the inclusion in the "*M.M.*" each month of photographs of various machines suitable for reproduction in Meccano, and we agree that features of this kind would be useful to those boys who live in the country and who may therefore be unable to study the machines at first hand. We believe that scarcely an issue of the Magazine has appeared that has not contained at least two or three illustrations of mechanical devices that would form excellent subjects for Meccano models; nevertheless, we shall bear your idea in mind. (*Reply to W. Tye, Ipswich*).

ENVELOPES FOR MECCANO CORRESPONDENCE.—We are interested in your proposal that we should introduce envelopes to match the Meccano Writing Pads, and we shall go into the matter carefully. (*Reply to G. Burkitt, Spalding*).

SQUARED STRIP ENDS.—We note your suggestion that the ends of Strips, Girders, Plates, etc., should be square cut instead of rounded as at present, but we are unable to see any advantage that would accrue from this alteration. The finish of the parts would certainly be greatly impaired. (*Reply to J. Wells, Warrington*).

Suggested New Meccano Parts

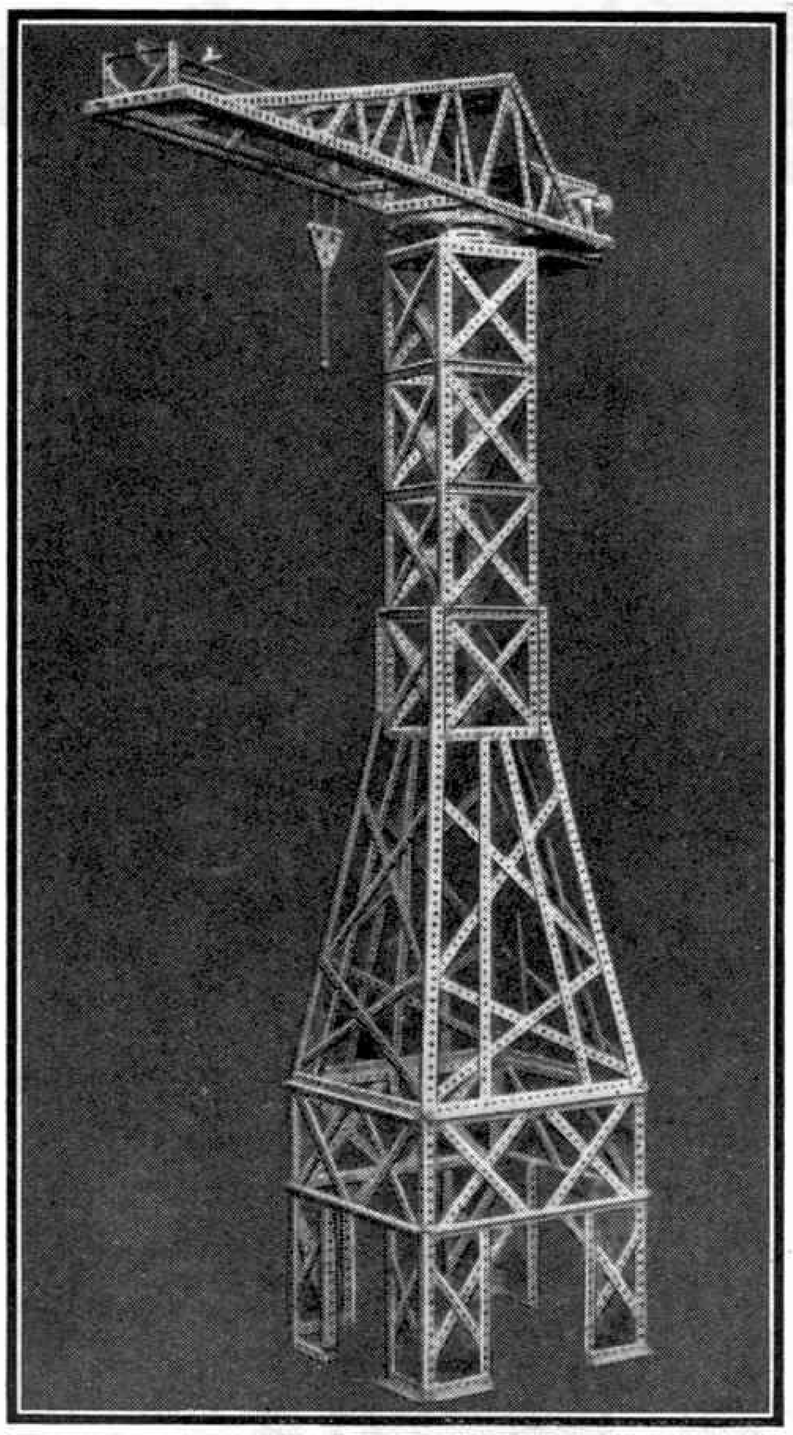
BELT MECHANISM.—As explained in the December, 1926, "*M.M.*," we doubt whether miniature leather belts would prove satisfactory on so small a scale. The question of belt driving mechanism in Meccano models is extremely interesting, however, and we are carefully noting all suggestions that we receive in this connection. For the present we advise readers to represent belt drives in their models by string or Spring Cord. Alternatively, strips of linen or tape will form quite effective substitutes. Of course, when an exceptionally powerful drive transmission is required between two distant shafts, it is advisable, as a rule, to use Sprocket Chains and Wheels, for it is impossible for a drive of this kind to slip. (*Reply to W. Tye, Ipswich*).

MECCANO BELL.—We agree that a small bell would be very useful in such models as Nos. 224, 314, 539, etc. Beyond the purposes indicated by these models, however, its range of utility practically ceases, and we therefore do not consider that it is a suitable part to add to the Meccano system. As you remark, a bicycle bell can easily be used when such a part is required. (*Reply to Victor Matthews, Toronto, Ontario*)

IMPROVED FORK PIECES.—We have previously acknowledged in these columns suggestions concerning the introduction of Fork Pieces having 1" sides (2 holes), and the matter is having attention. (*Reply to J. R. Thomas, Newport, Mon.*)

DUPLICATE SET-SCREWS.—We find that in almost every instance the single set-screw provides a sufficient grip with which to secure wheels and cranks, etc., and the expense that would necessarily be incurred by adopting your proposal for the provision of two set-screws in every boss is not justified. We would point out that in cases where abnormal strain is imposed upon a Crank or other part that is secured to an Axle Rod the necessary resistance can be obtained by duplicating the part in question. (*Reply to C. F. Moss, Sydney, Australia*).

Prize-Winning Radial Crane



This fine model of an elevated radial crane secured Second Prize in the recent "Crane" Competition for Reginald Pervanoglu, of Sydenham, S.E.26.

The horizontal boom is mounted on roller bearings and carries in the end of its shorter arm a 4-volt Electric Motor from which the hoisting, rotating, and traversing movements are all operated. It is interesting to note that the model stands over five feet in height, while the horizontal boom is 35" in length. The excellent proportions of the complete structure are well shown in the photograph.

RUBBER WASHERS.—We do not think it is necessary to introduce rubber washers to place under the heads of bolts when using the new coloured Meccano parts. The enamel employed is of the finest quality and should not scratch easily. If desired, the ordinary metal Washers may be placed beneath the bolt heads. (*Reply to E. Winn, London, S.E.*5).

IMPROVED SECTOR PLATES.—See our reply under this heading in the December, 1926 issue. (*Reply to W. E. Cheary, Forestville, S. Australia*).

4" PERFORATED STRIPS.—There is little demand for a strip having eight holes. Many different sizes of Strips are available, and when this particular length is required it should be quite simple to substitute two smaller Strips overlapped and bolted together. (*Reply to J. H. Thomas, Newport, Mon.*)

3½" × 2½" FLAT PLATES.—We find little demand for this part but we have noted your suggestions (*Reply to B. S. Braithwaite, Sedbergh, and Eric Jones, Northwich*).

DOG CLUTCHES.—We are considering the desirability of shaping the bosses of all Gear Wheels, Pinions, etc., to represent the female portion of the Dog Clutch. At present, however, we doubt whether the functions of these altered wheels would be sufficiently numerous or valuable to justify such a sweeping change in the design of the Meccano parts. (*Reply to J. C. Rishworth, Mettur Post, India*).

COUPLINGS FOR RODS.—We are interested in your suggestion regarding the introduction of thin metal clips with which to couple together two Axle Rods placed end to end. We agree that a number of Rods so joined might form a fairly efficient railway track, but we consider that a serious objection to your proposed part lies in the jolt—however slight—that would be imparted to a vehicle passing over the coupling-pieces. However, we shall give further consideration to the possibilities of the part. (*Reply to G. R. Marshall, Bromborough Pool*).

SLOTTED U-PIECE.—Your proposed slotted U-piece, in shape reminiscent of the Double Bent Strip, would certainly prove useful when it is required to slide a 57-teeth Gear Wheel longitudinally on its shaft, but we are unable to find any other use for the part. (*Reply to J. C. Rishworth, Mettur Post, India*).

HOISTING TACKLE.—All kinds of pulley blocks can easily be made with existing parts and we are therefore unable to consider the introduction of hoisting tackle as a complete unit. See Section III (Pulleys and Pulley Blocks) of the "Meccano Standard Mechanisms" Manual. (*Reply to J. Dalrymple, Stocksfield-on-Tyne*).

NEW STRIPS.—We have experienced very little demand for 10½" strips and 3½" curved strips. (*Reply to H. Hosegood, S. Norwood*).

SPECIAL SCREWDRIVER.—The existing "Extra Long" Screwdriver (Part No. 36a, price 6d.) measures 5" from tip of blade to commencement of handle and its shaft is specially designed to pass through the Meccano standard round holes. This tool will be found very useful when constructing the more complicated models. (*Reply to C. R. S. Agnew, Belfast*).

LARGER SPRING CLIPS.—We note that you have difficulty in securing a piece of cord to an Axle Rod by means of a Spring Clip. The best plan is to first secure a Collar or other part to the Rod and then tie the cord to the set-screw or, if a Bush Wheel or similar part is used, the cord may be secured in one of the holes in the face of the wheel. (*Reply to C. R. S. Agnew, Belfast*).

NEW FLYWHEEL.—Your suggested Flywheel would prove extremely expensive to manufacture and we do not consider it possesses any important advantages over the existing Flywheel (Part No. 132). The latter consists of die-cast white metal alloy and is 2¾" in diameter. It is equipped with a milled groove round its outer circumference and a small grooved pulley at its centre for use in connection with driving cords, etc. (*Reply to E. G. Hannaford, Belair, S. Australia*).

SPANNER AND SCREWDRIVER COMBINED.—The existing type of screwdriver with rounded handle does not lend itself to conversion to the composite tool that you describe. We would point out that it is frequently required to use the existing screwdriver and spanner simultaneously, and if these parts were substituted by your proposed single tool, it would be necessary to include two such tools in every Outfit. Hence no advantage would be obtained by combining the spanner and screwdriver into one unit. (*Reply to I. Harrison, Dudley*).

Suggested Hornby Train Improvements

MOTOR TRANSPORT WAGON.—We do not think that a motor transport wagon, complete with miniature motor car, would meet with much demand. We always endeavour to introduce only accessories that are likely to suit the requirements (and pockets) of the majority of Hornby enthusiasts, and the addition of accessories that do not pass this test merely results in an inconvenient complication of the Hornby System. (*Reply to Trevor Urben, Southampton; L. H. Porter, Forthill, Stoke-on-Trent; and S. Bruce, York*).

SHORTER CONTROL RAIL.—We regret it is not practicable to introduce a shorter Control Rail. Its present length is designed to enable the locos to pull up fairly gradually and without jerk. (*Reply to K. Clarke, London, S.W.2*).

SUPPLEMENTARY LEVER FRAME.—We shall consider your suggestions regarding the introduction of a smaller lever frame equipped with three or four white-painted levers for use as "spares" in conjunction with the present Lever Frame. It would no doubt be more economical to use these accessories in a layout that requires more than six levers for its operation, but we would point out that in such model railways greater realism and more fun might be obtained by using two complete Lever Frames, for these could be placed in different parts of the layout and a sectional or "block" system of signalling introduced. (*Reply to K. Clarke, London, S.W.2, and E. Lassdell, S.W.16*).

LAMPS ON CROSSINGS, ETC.—It would prove a very expensive matter to equip the Level Crossings, Electric Points, and Signal Cabins with small electric lights. On the other hand, those readers who desire such additions should experience little difficulty in fixing up small bulbs and lighting them from pocket flash-lamp batteries. (*Reply to N. E. Woods, Earlsfield, S.W.10*).

REPAIRS SHOP.—This would be a difficult accessory to manufacture and we do not think it would meet with much demand, for the majority of Hornby enthusiasts prefer to design their own "workshops" and "repair departments." Indeed, we know many boys who, when using their Hornby Trains, derive their greatest pleasure from the complete repair shops that they have devised from Meccano parts and equipped with all kinds of tools and working machines. (*Reply to N. E. Woods, Earlsfield, S.W.18*).

NUMBERS ON G.W. LOCO.—We regret to say that the inconsistency in the numbers shown on the loco and tender in the illustration of the No. 2 Pullman Set, G.W.R., on page 29 of the Hornby Book of Trains is due to an error made in the process of reproduction. The "2711" on the tender is the correct serial number. (*Reply to H. G. Sanders, Rossendale, and many others*).

NUMBERING, LETTERING, ETC.—We have frequently pointed out in these pages that, owing to our standardised methods of production, we find much difficulty in altering the lettering and numbers on the various types of loco in each railway group. Small changes in detail in this connection tend to produce disproportionate increases in cost of manufacture. Nevertheless we appreciate your suggestions and criticisms, and we may say that it is our intention to steadily improve upon our present selection of locos and to introduce new serial numbers wherever possible. We think you will agree that big strides have been made in this direction during the past two or three years. (*Reply to H. G. Sanders, Rossendale; C. Bunn, Wool, Wareham; and F. Jacobs, Hull*).

FOOTBRIDGE.—A model footbridge, to connect two station platforms, would certainly form an interesting addition to the series, and we shall give consideration to your proposal. Meanwhile the existing Footbridge with Signals might well be used for the purpose. (*Reply to A. Goodman, Burton-on-Trent*).

ALTERED METROPOLITAN COACHES.—We shall consider the question of colouring the existing Metropolitan coaches to represent other companies' rolling stock. (*Reply to J. Miller, J. Robbins, and L. F. Hall, London, N.W.2*).

SPRING COUPLINGS.—The advantages to be obtained from the addition of spring couplings to Gauge 0 rolling stock would be negligible. (*Reply to N. E. Woods, Earlsfield, S.W.18*).

ARTICULATED COACHES.—As stated in an earlier issue, we do not consider that the demand for articulated coaches is sufficient to warrant their introduction. Moreover, the manufacture of such accessories presents many difficulties. (*Reply to Terence Kenealy, Eastbourne*).

The Meccano Universal Coupling

Part No. 140 ... Price 9d.

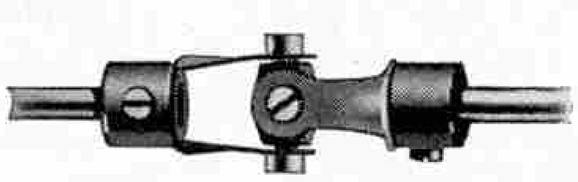


Fig. A

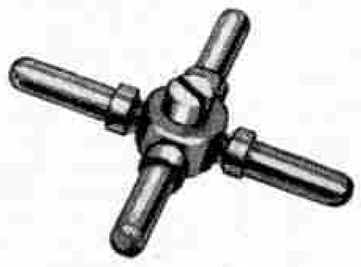


Fig. B

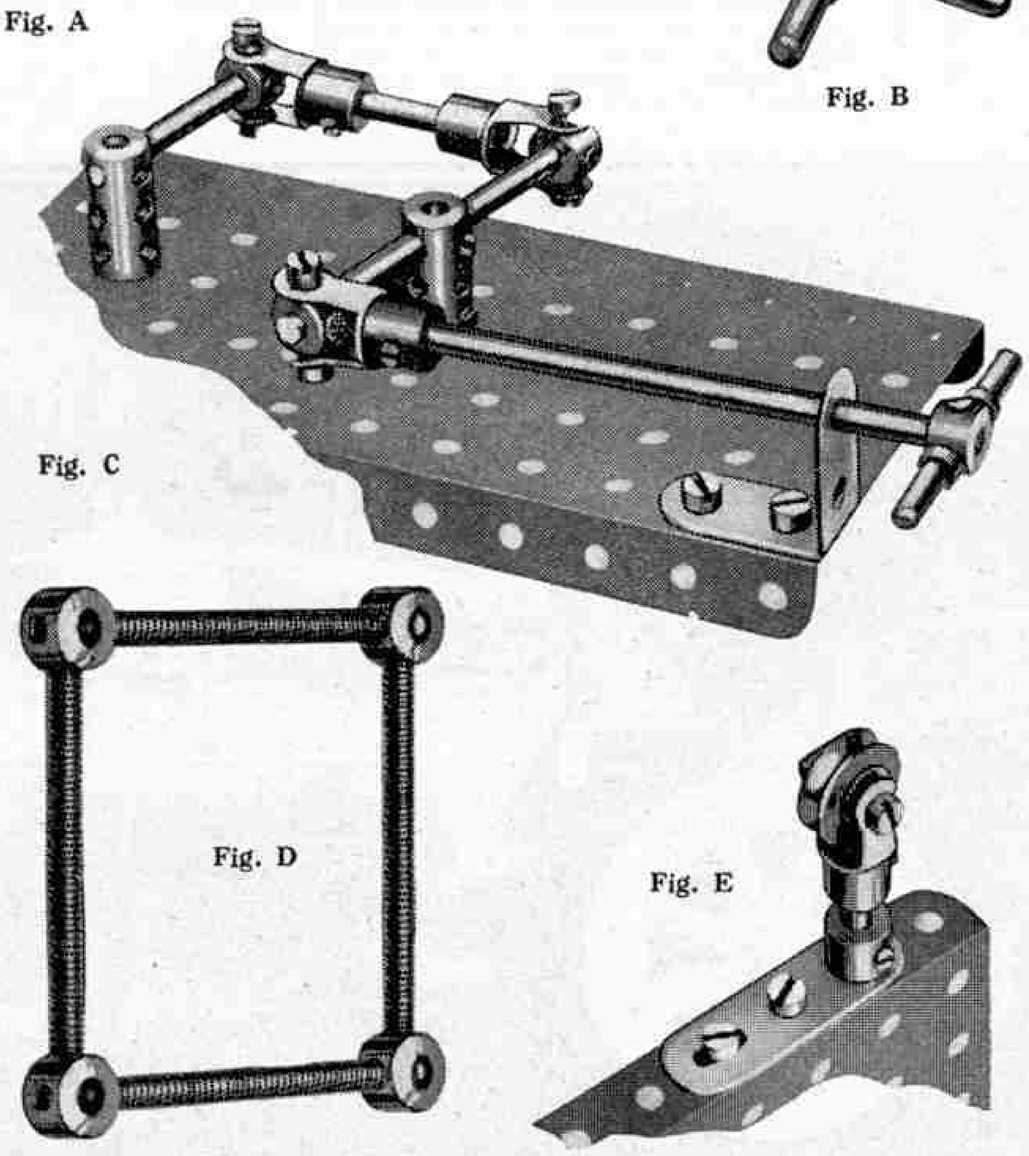


Fig. C

Fig. D

Fig. E

Readers have suggested from time to time a number of interesting new adaptations of the Meccano Universal Coupling (Part No. 140) or its component parts, and as we suspect there are many Meccano boys who do not use this part to the best possible advantage, we illustrate above some of the most practical of these suggestions.

The principal purpose of the Universal Coupling, or universal joint, is, of course, to connect two rotating shafts lying at an angle to each other, or to couple together two shafts, one of which is required to move radially about the end of the other while both are in rotation. It will be seen from the illustration of the complete unit (Fig. A) that the Universal Coupling consists of two forks or links pivotally attached to a central collar, which connection permits the shafts to turn freely at almost any angle to each other. In addition to this use of the part, the various components of the Coupling may easily be dissembled and employed for a variety of purposes.

Fig. B shows the centre collar of the Coupling used as a boss for a neat handwheel, the spokes of which consist of four Threaded Pins, while Fig. C includes three examples of the collar used in conjunction with one of the connecting links to form a pivotal right-angled connection between levers. A good example of this latter use of the part will be found in the construction of the Meccano Ackermann steering gear described in the February "*M.M.*" Fig. D indicates a further use of the centre collar in the construction of framework, handrails, etc.

The final example (Fig. E) shows one of the forks used as a bearing for a ½" loose Pulley. The latter is journalled on a ¼" Bolt carried in the fork, which may be secured to the end of any convenient Axle Rod. It has been pointed out that this forms an excellent method by which to secure a pulley to the trolley arm of a Meccano tram-car, or similar model.

ELECTRIFIED NO. 1 LOCOS.—We are experimenting with the electrification of No. 1 Locos. (*Reply to A. J. Evans, Bicester*).

BRAKE AND SIGNAL CONNECTION.—We shall consider your suggestion regarding a combined brake rail and signal. Meanwhile it should be a fairly easy matter to connect a signal with the brake rail in such a way that the former always shows "danger" when the brake is "up." (*Reply to A. J. Evans, Bicester*).

FLYWHEELS UNDER COACHES.—We are interested in your suggestion to the effect that heavy flywheels should be fitted beneath the coaches and connected by a system of gear wheels to the axles, thus enabling the trains to run longer and to start and stop more gradually. The improvement in the running of the trains would be slight, however, and we do not think that the advantages offered by your idea are sufficient to justify the heavy cost of production. (*Reply to A. Hodgkinson, Rossendale*).

CATTLE PENS.—As previously announced, we are examining the possibilities of model cattle pens and other fixed accessories for goods yards, etc. (*Reply to H. M. Mcfarlane, Plymouth; A. Hodgkinson, Fleetwood; B. Morris, Whitchurch; H. W. Jacomb, Godalming; D. L. Shaw, London, S.W.16; J. V. H. Cookson, Bury; A. J. Evans, Bicester; F. J. Wilcox, Stone; and others*).

OVAL BUFFERS.—We have received a large number of helpful and interesting letters in response to our remarks (in the January "In Reply" section) concerning the introduction of oval buffers in place of the present round type, with a view to preventing buffer-lock and derailments during shunting operations. Several correspondents point out that the alteration would represent a departure from actual practice in the case of certain types of trains, but nearly all are agreed that considerable advantages would be obtained from the introduction of oval buffers. We are now going into the matter very carefully. (*Reply to P. Sharp, Leamington Spa; L. Marson, Bexhill; W. R. Tomkins, London, S.W.16; J. R. Hughes, S.E.3; C. Dawe, S.E.17; C. Gilmour, Glasgow; A. Goodman, Burton-on-Trent; O. W. Lamballe, York; G. Innes, Winchester; J. K. Wright, Shipley; W. R. Hall, Gorton; P. J. Barkham, Redhill; and A. J. Evans, Bicester*).

INDICATOR LAMPS.—It would be a difficult matter to rearrange the engine lamps on every type of Hornby loco to agree with the standard code. Moreover, many readers prefer to use their locos to pull a variety of trains, ranging from a stopping goods to an express passenger train. See our remarks on detachable lamps in the "*M.M.*" for August, 1926. (*Reply to Leonard Rustom, Amersham, and F. S. Brown, Northwood*).

REVOLVING CRANE FOR PLATFORM.—A revolving crane is included in the Goods Depôt. Does this not meet your requirements? If other types of cranes are required for station platforms, goods yards, etc., we suggest that they should be constructed from Meccano parts. (*Reply to J. Thorburn, Kilmacolm*).

MUSTARD VAN.—A mustard van was included in the Hornby System at one time, but it did not prove as popular as our other accessories. Increased interest has lately been shown however, in this type of goods rolling stock—a fact that is due, perhaps, to the extensive activities of members of the now famous Mustard Club! (*Reply to J. Thorburn, Kilmacolm*).

LOADED GOODS TRUCK.—There would be little practical advantage in adding a goods wagon, ready loaded, to the Hornby System. It is quite easy to devise miniature articles of merchandise for this purpose (see our reply on this subject in last month's "*M.M.*") We shall consider your suggestion re the separate listing of the luggage included in the Platform Accessories Set No. 1. The milk cans, or tankards, included in the Milk Van may already be obtained separately, price 3d. each. (*Reply to J. Thorburn, Kilmacolm*).

INTERLOCKING SIGNAL LEVERS.—We fear it would not be possible to introduce an interlocking lever frame in the Control System, for the method of locking the various point and signal levers would depend upon the particular type of layout. It is possible that some keen Hornby-ites may be able to devise a system of interlocking levers for their individual requirements. (*Reply to R. J. Wilcox, Stone, Staffs.*)

TAR WAGON.—We doubt whether this accessory would prove popular. (*Reply to A. Goodman, Burton-on-Trent*).

Results of
Meccano Model-Building Contests

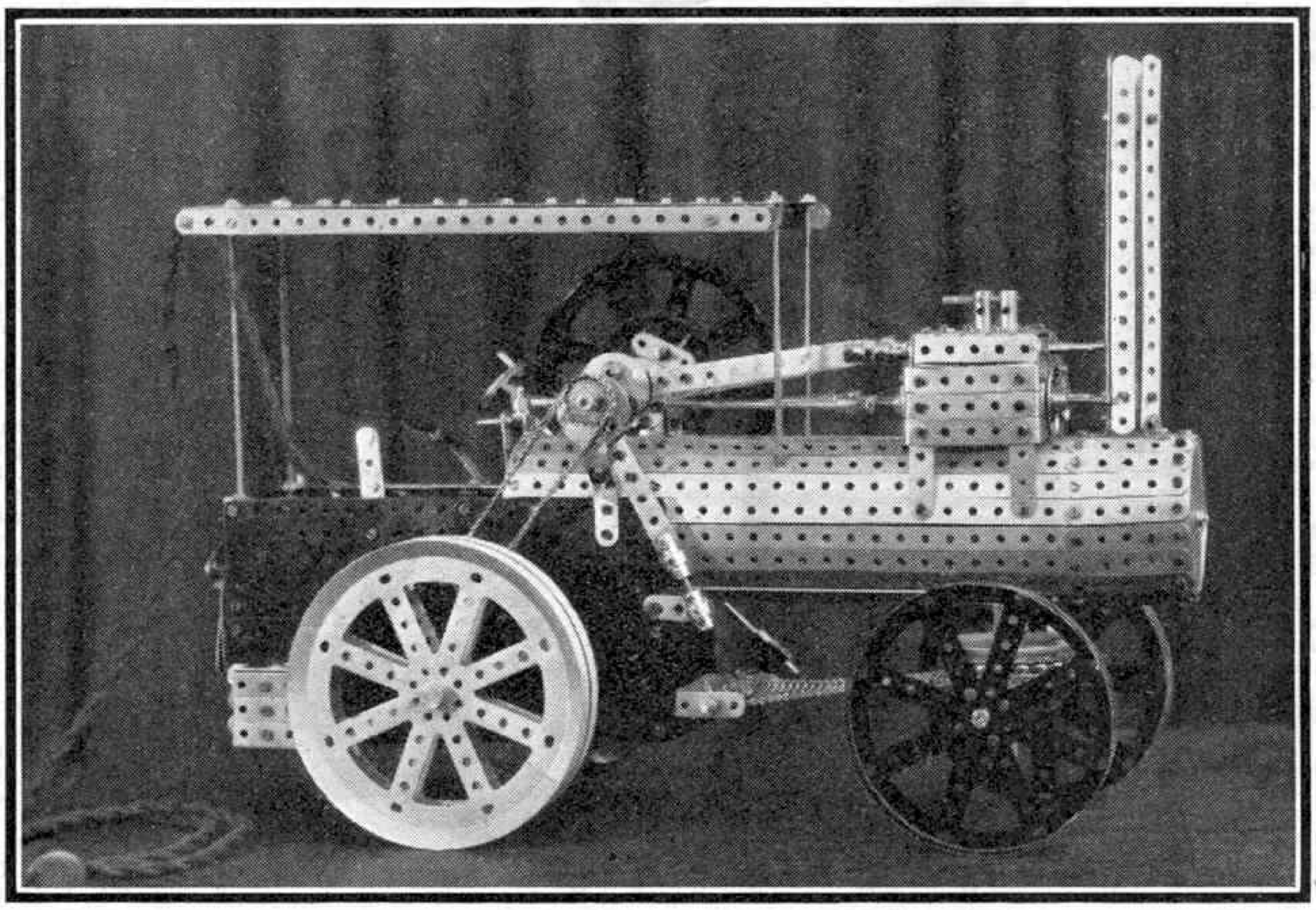
By Frank Hornby

November Competition, Section "B"

THE special model-building competition announced in the November 1926 "*M.M.*" has proved to be one of the most popular contests yet published in these pages. The exceptional number of entries is no doubt partly accounted for by the fact that the period allowed for building coincided with the Christmas holidays, and it is evident that many schoolboy readers made very good use of their leisure time.

It will be remembered that no stipulations were made as to the type of models to be submitted in this competition. We decided to give free rein to the inventive abilities of our readers and the popularity of the contest has more than justified that decision. Meccano boys will understand that the task of judging the entries in a competition of this kind is by no means easy; indeed, even now we have completed the allocation of awards in Section B only. This section comprises the work of boys whose ages range from 12 to 16 years and, incidentally, the number of entries in this particular section is larger than that received in either of the remaining two Sections under which entries from "home" competitors were classed.

The names of the prize-winners in Section B, together with a brief description of some of the models submitted, appear below. I hope to publish the results of Sections A, C (for U.K.) and D (Overseas) in the May or June issues.



Road Traction Engine, by W. Goodwin (aged 15). Awarded Second Prize

Section "B"

FIRST PRIZE (cheque to value £3-3s.): J. R. Grimsdell, 4, Greenhill Terrace, Weymouth, Dorset. Second Prize (cheque to value £2-2s.): William Goodwin, 140, Church Street, Eccles. Third Prize (cheque to value £1-1s.): Geoffrey Gregory, 105, Kingsbury Road, Erdington, Birmingham.

SIX PRIZES, each of Meccano products to value of half-a-guinea: S. Riley, Stowmarket, Suffolk; J. W. Vipond, Sunderland; H. H. Kershaw, Mytholmroyd, Yorks.; F. Burt, Erdington, Birmingham; J. Moore, Bradley, near Huddersfield; R. Muskett, Forest Hill, London, S.E.23.

CONSOLATION PRIZES (Certificates of Merit and Standard Mechanisms Manuals): P. Wing, Boston; P. Horner, Cross Hills, Keighley; R. B. Nichols, Weston-Super-Mare; R. J. Bromley, Kew Gardens, Surrey; E. B. Dobson, Springfield, Chelmsford; Maurice King, Golders Green, N.W.11; C. H. Harrison, Blackpool; H. Finch, Ayling Hill, Aldershot; C. P. Plantin, Westcliff-on-Sea.

SPECIAL COMMENDATION (Certificates of Merit): E. Wright, Nottingham; R. V. Bailey, Thames Ditton; R. Rutherford, Spital Tongues, Newcastle-upon-Tyne; K. C. Howick, South Nutfield; R. Sellar, Ashford, Middx.; G. A. F. Plunkett, Norwich; J. M. Glassborow, Amersham; D. J. Woollett, Edgworth, near Bolton; S. Reeves, Cheriton, near Folkestone; I. Williams, Trelow, Rhondda; G. F. Hayward, Ashford, Kent; A. Peters, Preston, Hitchin; S. J. Buckley, Luton; I. Dodd, Rock Ferry; F. N. Goodman, Brockley, S.E.4; G. Holmes, Blackpool; A. Geer, Hurstpierpoint; I. A. Donaldson, Woodford, E.18; P. Barry, St. Luke's, Cork; J. Campbell, Clydebank; H. Woodville, Hammersmith; W. R. Cromack, Scarborough; F. Hool, Grimsby; and P. G. Smith, Hove.

Certificates of Merit will also be awarded to a number of other competitors whose work is considered exceptionally good.

Parts Required to build Model Traction Engine illustrated above:

12	of No.	1	1	of No.	13	2	of No.	22	10	of No.	48	2	of No.	79	1	of No.	116
10	" "	1A	1	" "	13A	2	" "	25	4	" "	48A	2	" "	79A	3	" "	118
6	" "	1B	1	" "	14	4	" "	26	7	" "	48B	1	" "	80	1	" "	120A
4	" "	2	6	" "	15	3	" "	27A	1	" "	48C	2	" "	81	1	" "	125
2	" "	2A	4	" "	15A	1	" "	27B	3	" "	53	1	" "	90	3	" "	130
2	" "	3	3	" "	16	2	" "	29	4	" "	53A	1	" "	94	1	" "	132
6	" "	4	3	" "	16A	1	" "	31	1	" "	58	1	" "	95B	4	" "	136
24	" "	5	1	" "	17	1	" "	32	18	" "	59	1	" "	96	3	" "	137
3	" "	6A	4	" "	18A	277	" "	37	7	" "	63	1	" "	96A	2	" "	140
2	" "	8	6	" "	18B	18	" "	37A	2	" "	63B	6	" "	109	1	100-200 volt Electric Motor	
6	" "	11	2	" "	19B	50	" "	38	2	" "	63C	6	" "	111			
6	" "	12	4	" "	19C	1	" "	45	1	" "	64	2	" "	114			
18	" "	12B	5	" "	21	1	" "	47A	9	" "	70	2	" "	115			

Stephenson's "*Rocket*"

I have often thought that Meccano boys have somewhat neglected the model-building opportunities presented by some of the early inventions and machines of historic interest, and I have always looked for the appearance of this kind of model in the competitions.

The erection in Meccano of such famous inventions as Savery's or Newcomen's pumping engines, Watt's steam engine, early marine engines with, perhaps, paddle-wheel mechanism, and similar apparatus cannot fail to fascinate as well as to instruct the builder. It is true that several models of this description have been submitted at different times, but as a rule they have just fallen short of the standard required to win the principal prizes.

I was very pleased, therefore, to find that J. R. Grimsdell's model of George Stephenson's famous "*Rocket*" locomotive had been unanimously chosen by the judges for the First Prize in this competition. Unfortunately no suitable photographs are available for reproduction, but it is possible that the engine will be reconstructed in the Model Department at an early opportunity, when we should be able to include a full description of it in the "*M.M.*"

Meanwhile I may say that I regard the Meccano "*Rocket*" as a fine piece of work. One or two more or less important details are not included, but these omissions are due no doubt to lack of parts. It is interesting to note that the engine is driven by a 4-volt Electric Motor concealed within the boiler, while the necessary current is supplied by a Meccano Accumulator built within the "water-cask" placed on the tender. Hence the model is entirely self-contained as regards the motive power, yet no working parts

are visible except those found on the original locomotive.

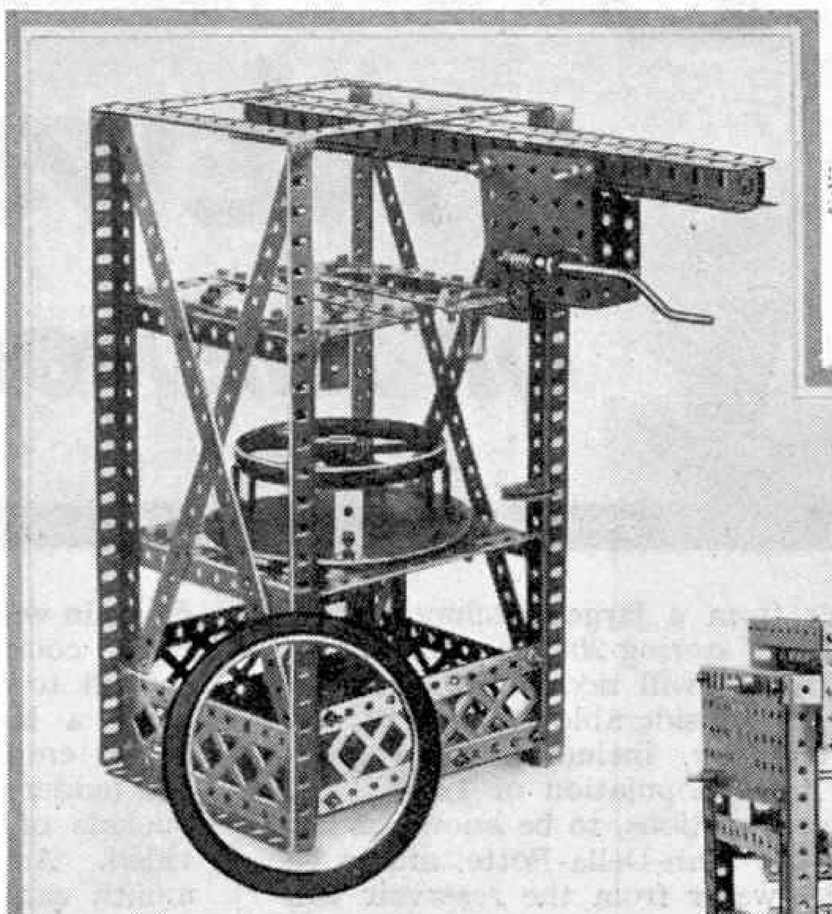
Steam Road Tractor

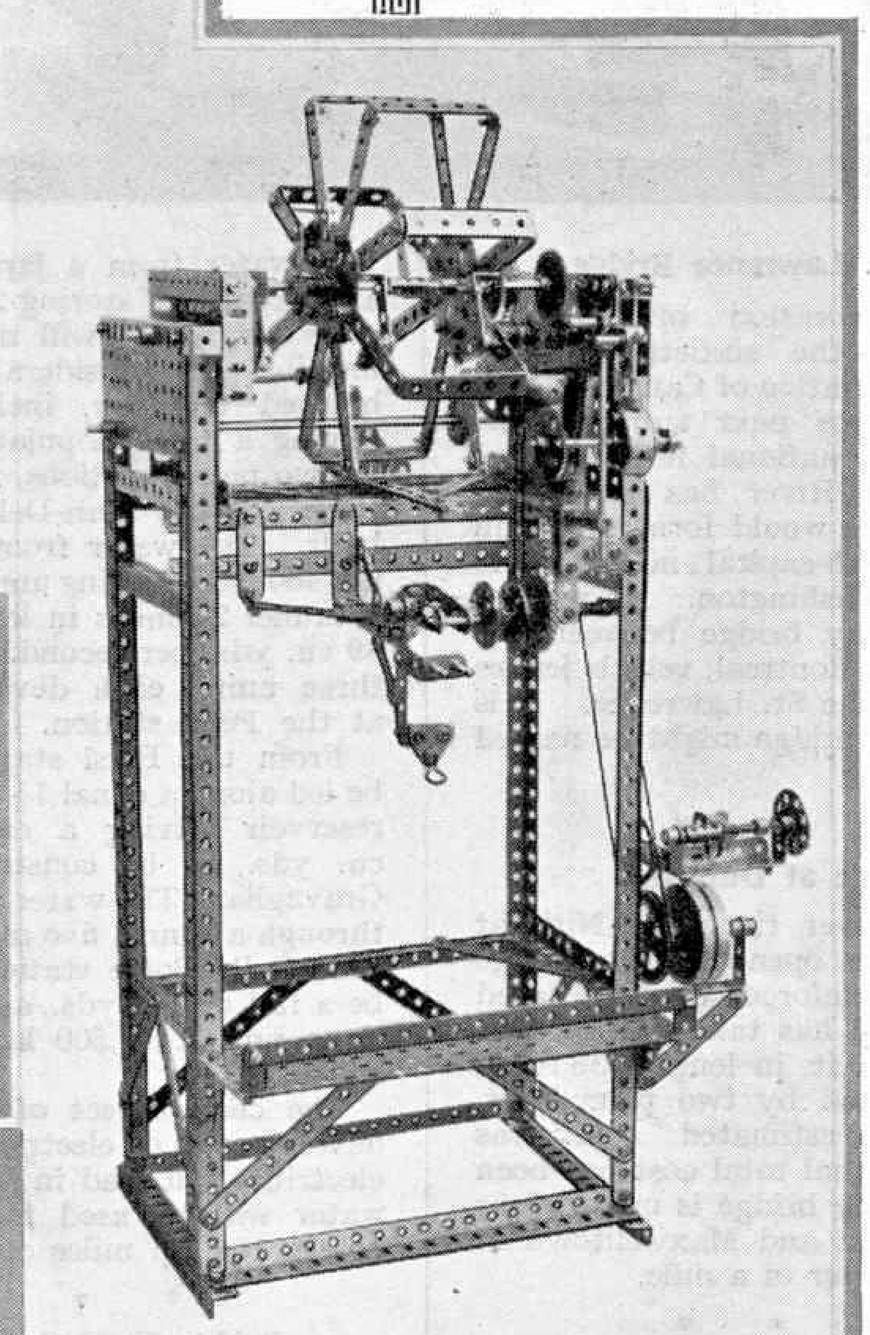
Apparently W. Goodwin specializes in road-transport vehicles for, following his success in the "Originality" Competition, in which he submitted a Foden six-wheeler, he wins Second Prize in this contest with the model traction engine shown in the accompanying illustration. The model is fitted with high and low pressure cylinders mounted on the boiler and equipped with slide valves operated by two eccentrics on the crankshaft. The flywheel consists of a Hub Disc bolted to a Bush Wheel. The pump shown in the photograph is composed of a short Axle Rod sliding in a Coupling and is operated by a further eccentric mounted on the end of the crankshaft. The steering is effected in a similar manner to the alternative method described under Standard Mechanism No. 118, the Sprocket Chain being secured to the front axle assembly and wound several times about the transverse shaft that is operated through Worm gearing from the hand steering wheel. It will be observed that ball bearings are included in the pivotal connection between the front axle and the boiler.

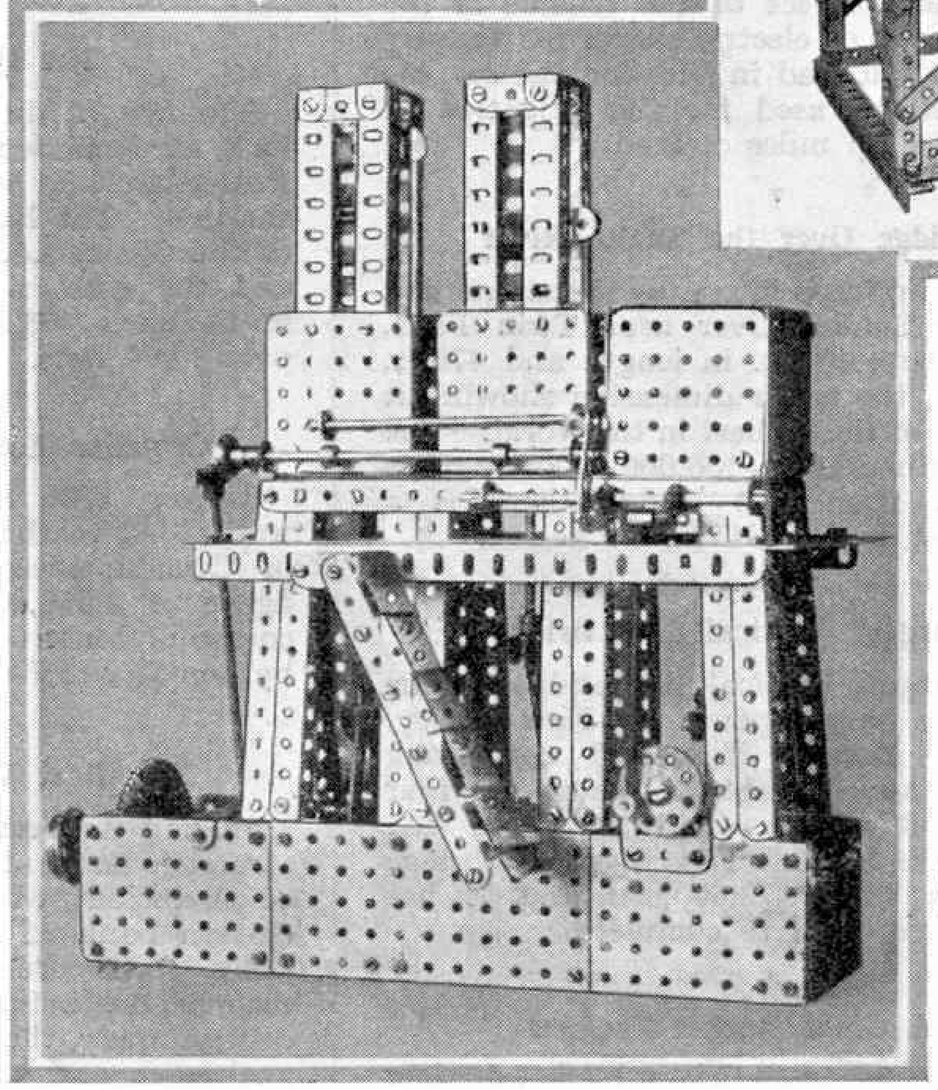
The final gear transmission is effected by a ½" Pinion driving a 3½" Gear Wheel that is free to turn on the rear "live" axle Two 1½" Double Angle Strips bolted to this Gear Wheel carry the planetary pinions of the differential, which is similar in design to Standard Mechanism No. 251. The model is driven by a high voltage Electric Motor mounted in a vertical position in the space occupied in actual practice by the fire-box. If desired, a 4-volt Motor may be substituted and a Meccano 8-amp. Accumulator could be housed in the coal bunker.

Other refinements of the model include tool-boxes, miniature hose-pipe (consisting of a coil of Spring Cord), mechanical horn, and screw-operated brakes. The transmission mechanism provides for neutral, forward, and reverse gears. A list printed on the preceding page shows the parts required to build the engine and this should prove helpful to those readers who wish to construct a similar model.

The Third Prize has been awarded to Geoffrey Gregory for a very fine representation of a modern touring car, the very complete equipment of which includes a three-speed gear box with "gate" change and internal-expanding brakes on all four wheels. The construction of the bodywork and design of the mechanical details included in the chassis are exceptionally good, and I hope to deal more fully with the model in a future issue.







Above: Solid Tyre Press, by J. W. Vipond.
Centre: Reeling Machine, for Artificial Silk, by S. Riley.
Below: Twin-Cylinder Marine Oil Engine, by Houghton Kershaw.
All Cash Prizes.

Other Interesting Entries

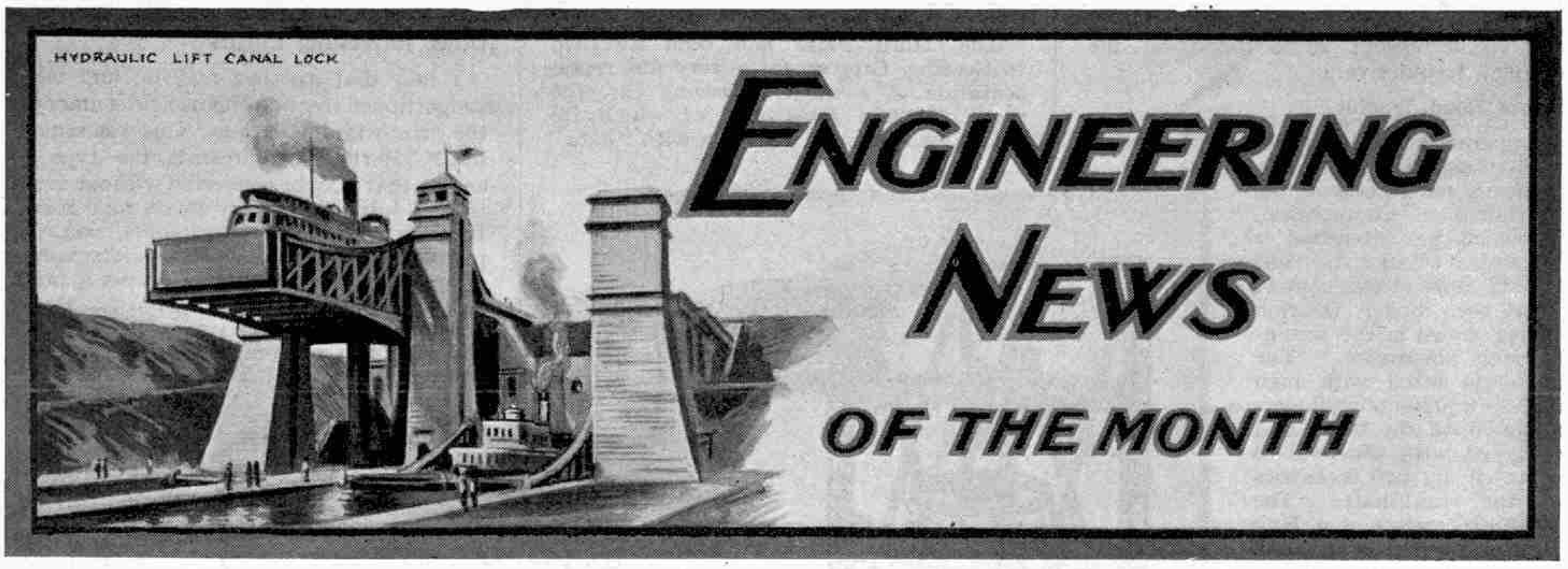
I find that another realistic and well-proportioned traction engine figures amongst the prize-winning entries. This was sent in by F. Burt and represents the type of engine that may be converted without much trouble into an ordinary steam road roller. It is fitted with two cylinders, working pistons and connecting rods, safety valve, lamps, etc., and altogether forms a most pleasing model.

The first of the three very original entries shown on this page represents a tyre press, and was sent in by J. W. Vipond. Although forming a very interesting Meccano structure, this model cannot be put to actual work, of course.

S. Riley's artificial silk reeling machine contains several entirely new and very ingenious Meccano mechanisms. Amongst these is a device whereby the machine is automatically thrown out of gear immediately a break occurs in the yarn and also when a specified length of yarn has been paid out. One of the arms of the reel is collapsible; this permits the silk, etc., to be easily withdrawn after winding. An efficient belt-clutch control device will be noticed in the lower right-hand side of the illustration. The clutch itself is based, of course, upon the principle outlined under Standard Mechanism No. 18a, but the movement of the belt from one driven pulley to another is obtained by rotating a hand-wheel secured to a Threaded Rod. The belt-guide moves longitudinally upon the latter Rod.

H. H. Kershaw's model marine engine is of the Doxford twin-cylinder opposed piston type, each cylinder being fitted with two pistons. Owing to the formation of the crankshaft, these pistons work in an opposite direction to each other; that is to say, when one advances towards the centre of the cylinder from the top end, the other rises from the lower end, and vice versa. The upper piston is connected to a cross-piece, which, in turn, is connected at each end to vertical rods (partly shown in the illustration). These Rods are jointed to connecting rods, by means of which they convey the power to the crank-shaft. The model is complete with scavenger, valve gear, etc.

R. Muskett's entry is in the form of a grain elevator, in which a continuous chain of Meccano Dredger Buckets is employed to convey the grain to the chute.



Proposed St. Lawrence Bridge

As a commemoration of Canada's Diamond Jubilee—the sixtieth anniversary of the Confederation of Canadian Provinces, taking place next summer—the erection of an international bridge across the St. Lawrence River has been proposed. This bridge would form the main link in a capital-to-capital motor route from Ottawa to Washington. At present there is no highway bridge between the Niagara River and Montreal, vehicle ferries being used across the St. Lawrence. It is suggested that the bridge might be named the Rainbow Arch.

* * * *

New Bridge at Dumfries

A new bridge over the river Nith at Dumfries has been opened. The bridge is constructed of reinforced concrete faced with freestone, and has taken 18 months to build. It is 170 ft. in length, 36 ft. in width and supported by two piers 7½ ft. in width. The estimated cost was £29,950 but the actual total cost has been about £50,000. The bridge is one of four connecting Dumfries and Maxwelltown in the space of a quarter of a mile.

* * * *

Gold Dredging Developments in Alaska

An extensive programme of gold dredging development is to be carried out in Alaska in the Fairbanks district. The scheme includes the diversion of water from the Chatanika River and the conveying of it to the scene of dredging operations by 80 miles of open ditch and some five miles of steel syphons to take it across streams and ravines. A steam-electric power plant is to be erected at Fairbanks that will have a capacity of 8,000 k.w., and this current will provide the power required for the dredgers, seven of which will be put into use.

* * * *

The suspension bridge in Glasgow across the Clyde is to undergo a thorough repairing and overhauling for the first time since it was built—rather more than 50 years ago. These operations will involve the closing of the bridge for a considerable period.

* * * *

Italian Hydro-Electric Scheme

An important hydro-electric scheme in the Val Borbera has been approved by the Italian Minister of Communication.

The chief work will be the construction of a large artificial lake or reservoir, absorbing water from a large catchment area and capable of storing 208,000,000 cu. yds. of water. This will necessitate the submersion of considerable tracts of inhabited territory, including three areas having a total population of 1,500.

Two power stations, to be known as the Persi and the Pian-Della-Botte, are to be built. The water from the reservoir will fall 460 yds., passing under pressure through a tunnel 2½ miles in length at the rate of 39 cu. yds. per second. It will then drive three units, each developing 9,000 k.w., at the Persi station.

From the Persi station the water will be led along a canal 1¼ miles in length to a reservoir having a capacity of 784,000 cu. yds., to be constructed on the Rio Gravaglia. The water will pass from there through a tunnel five miles in length to the Pian-Della-Botte station where there will be a fall of 120 yds., and where a plant of three units of 4,500 k.w. each will be installed.

The chief object of the scheme is the development of electric power for railway electrification, and in addition the surplus water will be used for the irrigation of nearly 100 sq. miles of land.

* * * *

Bridge Over the Snake River

A new bridge is in course of construction over the Snake River near Twin Falls. It is to be 1,400 ft. in length and 476 ft. in height, the latter dimension showing it to be one of the highest in the world. The cost is estimated at £130,000. A few miles upstream from this bridge there is a suspension bridge 345 ft. in height.

* * * *

Largest Vertical Lift Bridge

The largest vertical lift bridge in the world has been opened at New Jersey, spanning Newark Bay and connecting Bayonne and Elizabeth. There are four spans each 260 ft. in length, and the clearance is 135 ft. The cost of the bridge has been about £2,600,000 and it has taken three years to complete.

* * * *

A Giant Bucket Dredger

A new steel steam-driven bucket dredger is now being operated at Tanjong Toh Allang in Malaya. It has been designed and constructed entirely in Singapore with the exception of certain specialised parts imported from Great Britain. The dredger is one of the largest in operation in Malaya, the pontoon being 174 ft. in length and 54 ft. in width, and divided into 30 watertight compartments. Dredging can be carried to a depth of 70 ft. below water level, a bucket ladder 135 ft. in length being employed. The total weight of the ladder and buckets is 300 tons, 113 buckets of 9 cu. ft. capacity being provided. An area of 240,000 cu. yds. per month can be excavated.

* * * *

Digging a Canal with Dynamite

During the construction of a drainage canal in Louisiana, dynamite was used by the contractors for excavating the channel, in preference to the usual method of dredging. The sticks of dynamite were placed along the canal site and fired electrically and in less than a day a channel was blasted out that would have required about a month to dredge. The cost was roughly one shilling per cu. yd. as against five shillings based on dredging costs.

* * * *

The Ijmuiden Lock

The first of the three gates for the new lock at Ijmuiden has been launched at Rotterdam and will be towed to its destination. The lock will be twice as large as the Gatun Lock on the Panama Canal and the gate is 180 ft. in length, 28 ft. in thickness, 66 ft. in depth, and weighs over 1,000 tons.

* * * *

Canadian Electrical Development

During 1926 a total of 266,000 h.p. was added to the hydro-electric resources of Canada, increasing the total to the figure of 4,556,000 h.p. Schemes now in course of construction will raise this total by another 1,700,000 h.p.

* * * *

New Port Works at Asuncion

Plans have been prepared for the reconstruction and extension of the river port of Asuncion, which is situated on the eastern bank of the Paraguay river, 827 miles from Buenos Aires. The plans include the building of 545 yds. of additional quay, the deepening of the present anchorage and the increase of the river channel to 150 yds. in breadth. Two large warehouses 110 yds. by 25 yds. are to be erected and 10 electric cranes of 1½ tons each and one of 10 tons will be installed on the quays. The work will take three years to complete at an estimated cost of £550,000.

New Cologne Bridge

The new bridge to be built over the Rhine at Cologne, between the suburbs of Riehl and Mulheim, is to be a high-level bridge with a clearance of 131 ft. 3 in. above normal water level, and will consist of one span, 109 ft. in length. Messrs. Fried Krupp of Essen have gained the contract to provide the steelwork and carry out the erection of the bridge, at the estimated cost of eight million marks (£400,000), and Messrs. Schluter of Dortmund will be responsible for the foundations and approaches, their estimate being 3,400,000 marks (£170,000). The total estimated cost is 13,000,000 marks or £750,000. The material to be used includes 15,157 tons of wrought iron and 48,470 tons of cast steel.

* * *

Largest Reinforced Concrete Bridge

What is stated to be the largest reinforced concrete bridge yet constructed has recently been completed. This bridge consists of thirteen arches of a clear span of 283 ft. 4 in., and stretches across the Minnesota River between Fort Snelling and Mendota, Minn. The total length of the structure is 4,119 ft. including shore approaches, and 76,000 cu. yds. of concrete were used in the constructional work.

* * * *

Oil Tankers for United States

Contracts have been placed by the Gulf Refining Company of Pittsburgh, Pa., for six vessels of a total value of £1,000,000. Three of these ships are to be constructed by the Furness Shipbuilding Co. Ltd., Haverton Hill-on-Tees, and will be oil tankers built to carry 15,000 tons deadweight, and driven by Doxford-Diesel engines. The other three vessels are to be built by Palmers Shipbuilding and Iron Co. Ltd., Jarrow-on-Tyne, and will be twin-screw oil tank steamers of about 3,700 tons deadweight each.

The machinery for all six vessels is to be constructed by Richardson, Westgarth & Co. Ltd., of Hartlepool.

* * * *

A proposal to re-open the Grand Canal between Tientsin and Tungchow, a town near Peking, has been discussed by merchants in Peking and Tientsin. The canal is over 50 miles in length and it is hoped to compel the railway companies to reduce their charges by the use of this alternative route.

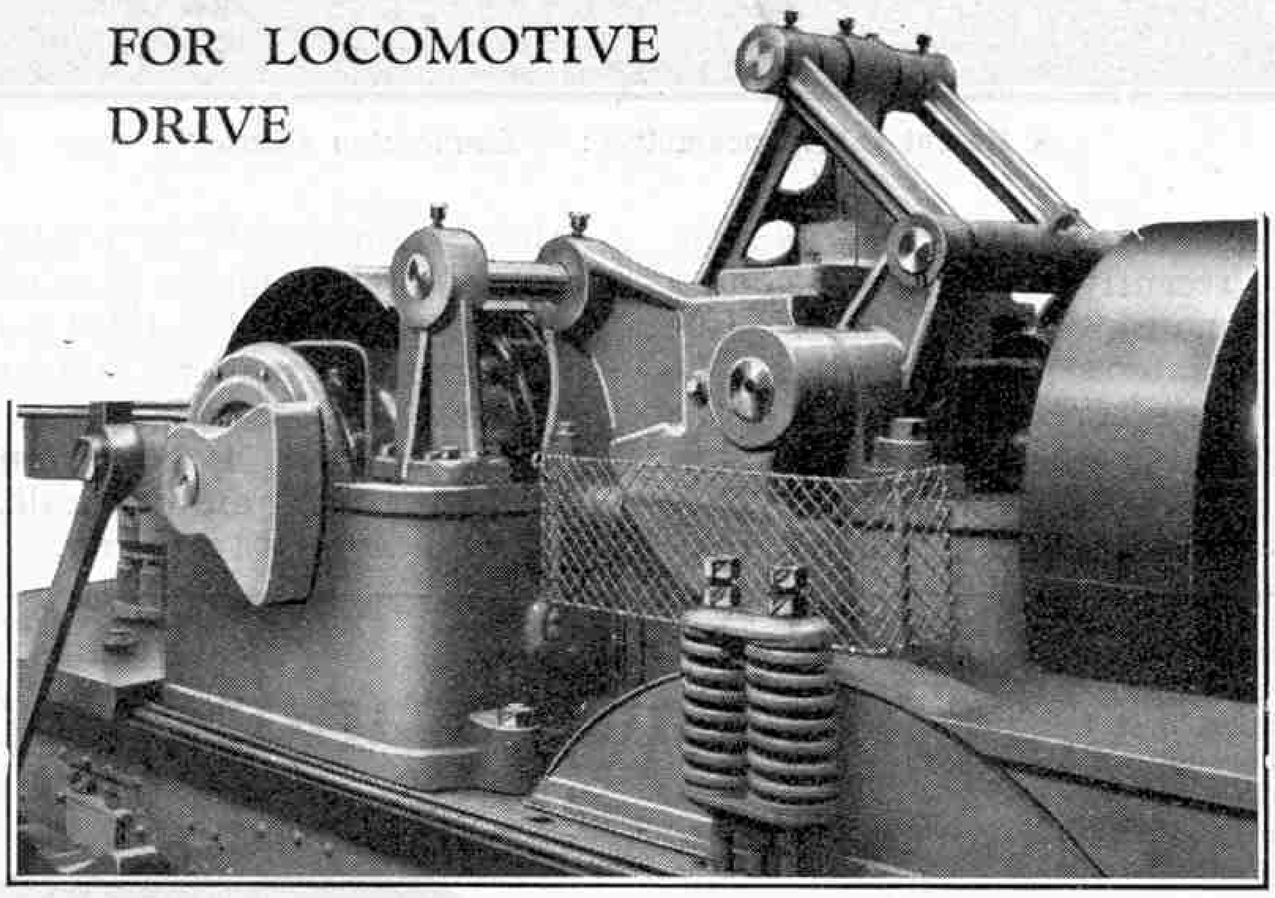
* * * *

It is possible that part of the present Bradford tramway system will be replaced by trackless trolley vehicles. It is estimated that the change would cost £29,560, including the provision of overhead equipment and vehicles.

Trawler Hauls up Lorries

An interesting haul was recently made by a North Sea trawler. This consisted of two motor lorries, presumably part of a cargo of army lorries on a ship sunk during the war. One lorry of French manufacture was completely ruined, but the gear-box of the other, an A.E.C., proved to be in working order, the gears having been completely protected by a water-tight gear-box.

TORQUE CONVERTER FOR LOCOMOTIVE DRIVE



250 horse power Constantinesco Torque Converter for locomotive drive. No clutch or gears of any kind are used between the engine and the driving axles. See special article on page 350 in this issue

Record Ship-to-Shore Wireless

Wireless communication between the Cunard Liner "*Carinthia*" when lying off Leeuwin, Australia, and the New Brunswick station, New Jersey, over a distance of 12,500 miles, has set a record for ship-to-shore commercial transmission. The ship was fitted with a special short-wave transmitter by Siemens Bros. & Co. Ltd., of Woolwich, and employed a specially constructed transmitting valve.

* * * *

London Motor Coach Station

London's first motor coach station is to be opened at Brixton early in July, and will provide facilities for the embarking of about 1,000 people. The station is to have a 90 ft. frontage opposite Lambeth Town Hall with an open space, 50 ft. in depth, between the road and the front of the building.

* * * *

The Bologna-Florence Tunnel

The Bologna-Florence Tunnel was commenced in 1913, but work was abandoned in 1914 owing to the war. In 1923 work was restarted and the tunnel probably will be completed in 1930.

The tunnel will be 18.51 km. (about 12 miles) in length and will reduce the time for the railway journey between Bologna and Florence from 3½ to 1½ hours and the distance from 130 km. (80 miles) to 97 km. (61 miles).

Henry Ford Refuses £200,000,000 for his Business

Mr. Henry Ford has refused an offer of £200,000,000 for his motor business from Mr. W. Prentiss, a member of an American brokerage firm. Last year the output from the Ford works was 1,810,027 cars and the net profit exceeded £20,000,000.

Mr. Ford has now started the business of remaking used cars. These are sent to the Detroit factory and there put through a repair process, planned on similar lines to the manufacturing process and costing about £12. It is estimated that 15,000,000 Fords have been produced, so that the number of old ones available for reconditioning is sufficient to make quite an extensive addition to Mr. Ford's activities.

* * *

Large Electric Winders for N.S.W.

The Metropolitan-Vickers Electrical Company have obtained contracts from colliery companies in New South Wales for two large winders.

One of these equipments has been ordered by the Caledonian Collieries Ltd., and is to be installed at the Aberdare Central Colliery near Newcastle. This winder is to be driven by two direct-current motors capable of developing 11,250 h.p. These motors will be directly coupled to a cylindrical winding-drum 14 ft. in diameter, rotating at 57 revolutions per minute. The equipment has been designed to haul a net load of 7½ tons of coal up a shaft 1,200 ft. in depth, giving an output of 490 tons per hour.

A similar winder is being installed by Messrs. James & Alex. Brown, of Richmond Main Colliery. In this case the equipment is required to hoist a net load of six tons of coal from a depth of 920 ft., at the rate of 400 tons per hour.

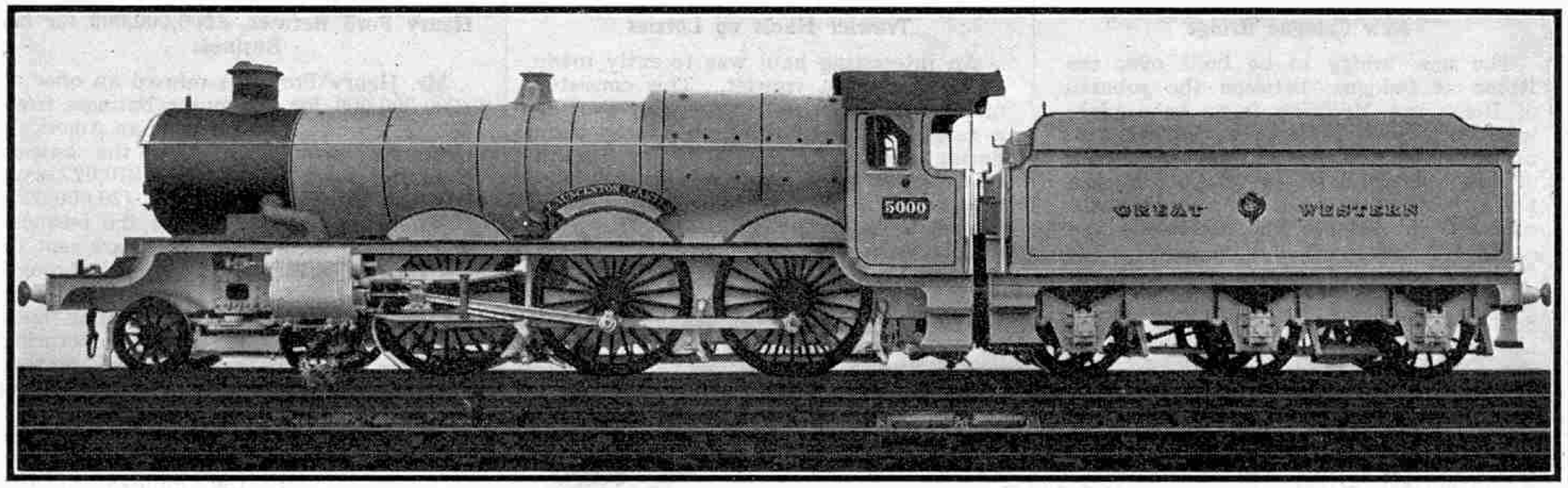
* * * *

The Liverpool Corporation have decided to install a second generating set in the new Lister-Drive electric power station. The total supply in Liverpool for industrial and domestic uses will then amount to 170,000 h.p.

* * * *

A Winged Motor Boat

A new type of motor-boat has been launched in France and is stated to have attained a speed of over 60 miles an hour during tests. The boat consists of a sort of flying-boat hull having wings with a 9 ft. spread attached. At a certain speed the lift exerted by the hull and wing-spread is sufficient to allow the vessel to hydroplane along the surface of the water. The boat is driven by an aeroplane engine and propeller, and is provided with a pair of floats, one at each side, in order to secure lateral stability.



A Recent G.W. Locomotive: "*Launceston Castle*"

Our photograph shows No. 5000, "*Launceston Castle*," one of the most recently constructed engines of the G.W. Railway's famous "Castle" class. This locomotive is specially of interest, because it is the first to be fitted with the new type of tender that the G.W.R. is introducing for use with its long-distance expresses.

As will be seen, the tender is somewhat higher than the standard G.W.R. tender owing to the tank being placed slightly higher than the foot-plate. Accommodation is provided for 4,000 gallons of water and six tons of coal, the tender's weight when fully loaded being 46 tons 13 cwt. The plates forming the coal space are sloped toward the centre and front of the tender, the coal thus being automatically fed to the shovel, making the tender self-trimming.

The Eclipse of the Sun—(*con't. from page* 295)

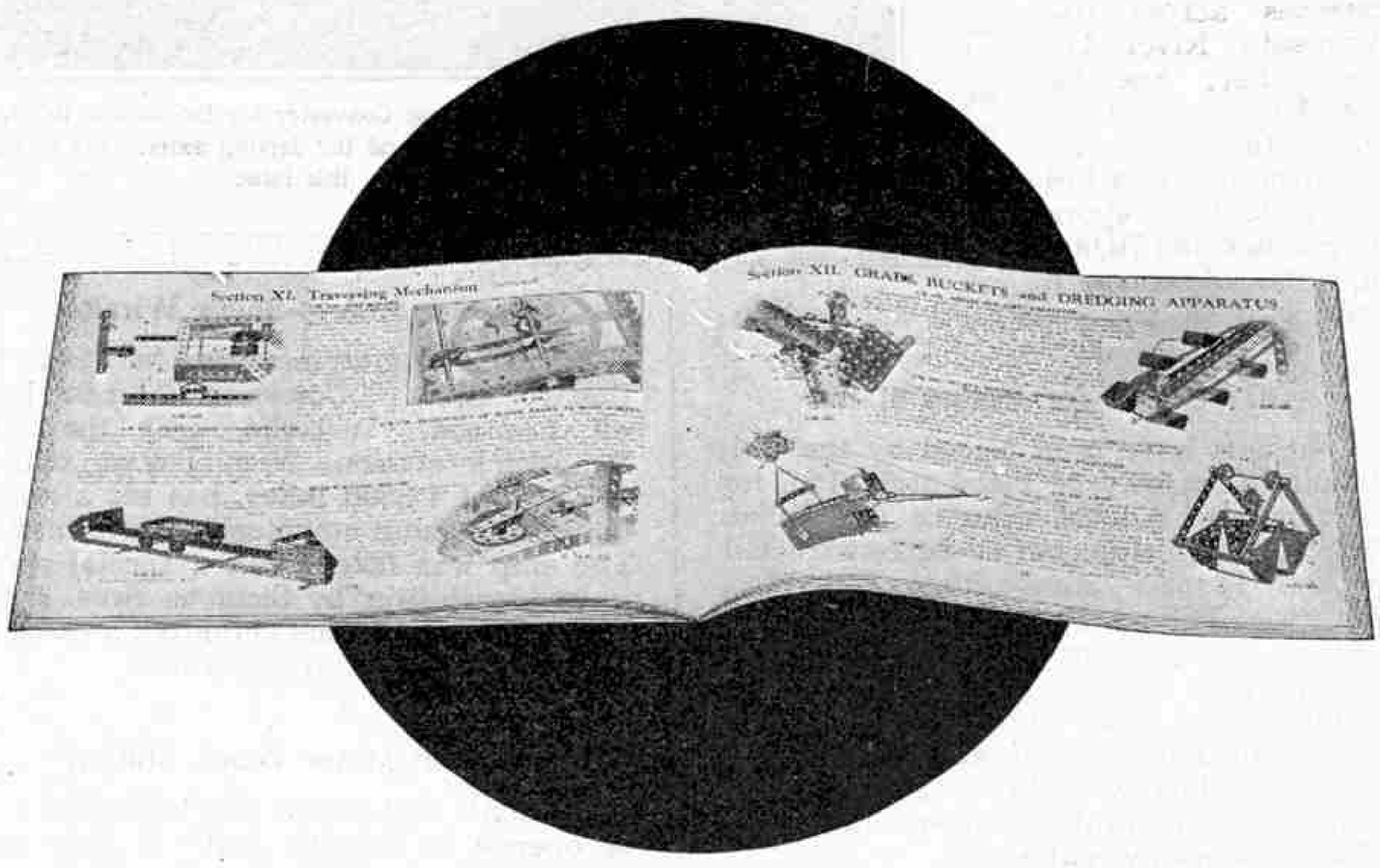
prominence is obtained by comparing it with the Earth. This is usually done by drawing somewhere on the photograph a circle of the size of the Earth on the same scale. In this particular case the Earth would be represented by a mere dot one fortieth of an inch across.

The prominence of 1919 was of the kind called eruptive, but at times very quiet prominences are seen, the shape and position of which remain practically unaltered for a considerable time. This is well illustrated by the photographs on p. 294 taken at the Yerkes Observatory in 1910. On the right of each photograph is an eruptive prominence, the second photograph having been taken some time later than the first, as the change in shape and position shows. But the small prominence at the left remained almost unchanged all the while. These quiescent prominences often assume the shape of clouds, sometimes showing delicate cirrus forms and at others those of heavy cumulus clouds. They are usually connected to the chromosphere by a slender column or stem, presenting the appearance of a fantastic and fiery forest.

The study of the prominences and the other striking features of an eclipse is indeed, very fascinating, quite apart from its scientific importance. Astronomers are eager to take advantage of every opportunity that may present itself of observing an eclipse, and the great improvement in travelling facilities that has taken place during the last hundred years has enabled them to make expeditions for the purpose to almost every quarter of the globe. They have had many strange experiences and in some cases have run considerable risks. It is still more remarkable, however, that some members have been so keen on their tasks that they have never seen the eclipse itself at all!

These expeditions must necessarily be very highly organised and next month we shall describe how the organisation is carried out so that the short period of totality is used to the best advantage.

"Meccano Standard Mechanisms"



There is a large number of Meccano movements that may be applied to more than one model—in most cases without any alteration, but in some few instances with only slight alterations to the original movement. These have been collected and classified, and a selection has been published in each issue of the "*M.M.*" for the last few months as "Standard Mechanisms."

The entire collection may now be obtained in the form of a new Manual entitled "Meccano Standard Mechanisms." All the movements are described in this book in a clear and detailed manner, and the publication should be of special value in assisting inventive boys to embody correct engineering principles in their new structures. The various devices have been arranged so that immediate reference may be made to any particular motion that it is desired to incorporate in a model. No keen Meccano boy will consider his equipment complete without a copy of the "Standard Mechanisms" Manual.

The price of "Meccano Standard Mechanisms" is 1/1½ post free. Overseas, price 1/7½ post free. It may be obtained from any Meccano dealer, from our Overseas agents (addresses on page 384), or direct from Meccano Ltd., Binns Road, Liverpool.

Banking and Piloting

When and Why Two Engines are Used

By Gerald W. Spink

MOST Meccano boys are familiar with the terms "banking" and "piloting," as applied to railway work. Some of them may perhaps have carried out these operations on their own model lines if they have more than one loco and a number of coaches and wagons.

Piloting is sometimes called on the railways "double-heading," because two locos are used at the front of a train instead of one. The usual reason for piloting is that a train is exceptionally heavy. On most of our British railways the matter of load regulation is taken very seriously indeed, and each type of loco is allotted its load according to its tractive power. Only in the most exceptional circumstances may this limit be exceeded, and if it should be found necessary to add more coaches to the train than the loco is permitted to take, an additional or pilot loco has to be provided.

Sometimes double-heading has to be resorted to, even when one powerful loco could do the work. The explanation of this is that the powerful loco is too heavy to be allowed to cross certain bridges. Two smaller locos, though their combined weight may exceed that of the large one, do not cause so much weight per driving-wheel to press upon the bridge, and therefore the strain is comparatively light.

"*M.M.*" readers may have been puzzled occasionally to see a train of only a few coaches, on a level section of line, being hauled by a couple of locos, even where there were no unusual weight restrictions for bridges, etc. In such a case it is probable that one of the locos had worked a train away from its own shed, say in the morning, and had no suitable train to bring back in the afternoon. As this loco was wanted "at home," it was worked back along with a train that already had a loco. On our well-organised lines this sort of thing does not happen very often, but occasionally it cannot be avoided, especially at holiday times, when there are extra excursion trains. In such circumstances it is more satisfactory to double-head than to return the loco "light," that is without a train, for this would entail extra signalling and perhaps would cause traffic delays.

Sometimes two trains are run as one, their locos being coupled at the front. For example, during the summer months there is a north to south train in Scotland that has a portion for Edinburgh and one for Glasgow. Between Stirling and Larbert the two portions run as one train. At Larbert one of the locos comes off to allow the other to take on its train, and the first loco then backs on to its own coaches, which have been left standing.

It is interesting to note that while all railways have a system of load regulation, a London and North Eastern "Pacific" has been known to haul 20 main-line coaches between London and Grantham, over 100 miles, at an average speed of more than 50 m.p.h.

Banking on the railways is the practice of providing a loco at the rear of a train to assist it up a severe gradient. Sometimes a banking-engine will push for a few yards only, for example at St. Pancras Station, giving just sufficient help to get the train away, after which the leading loco can do all that is required without undue strain. On the other hand, on certain heavily-graded routes banking-engines may be used continuously for miles. For instance, on the famous "West Coast Route" there are no less than three places between Euston and Perth where a banking-engine may be used. The first is at Oxenholme, where a heavy train will be banked up to Shap Summit, after which the few remaining miles to Carlisle are comparatively easy and mostly down-hill. North of Carlisle a banking-engine is usually attached at Beattock to enable the formidable climb there to be negotiated. Lastly, trains are sometimes helped from Stirling as far as Kinbuck, a distance of about nine miles.

When banking-engines are used they are fitted with slip-coupling so that when the summit point has been reached the train need not stop to detach the "banker." The driver of the latter or his fireman pulls a rope or wire, thus slipping the couplings, and so the loco comes to a stop while the train goes forward.

Goods trains are frequently banked, for when there is a loco behind the train there is little danger of couplings being snapped on a heavy incline.

One of the most interesting examples of banking is to be found on the L.N.E.R. at Queen Street Station, Glasgow. There the line rises severely, and to complicate matters there is a long tunnel. Formerly, trains were hauled up this incline by means of a steel cable connected with a stationary steam engine at the head of the bank. This method was found to be too costly and difficult to work, and therefore banking-engines were introduced. To-day almost every train there receives the assistance of a "pusher."

The Lickey Incline on the Midland Railway provides another famous example of banking. This incline commences at Bromsgrove and ends at Blackwell and consists of two miles at a gradient of 1 in 37.7 to be climbed by trains from Bristol towards Birmingham. Almost all trains are assisted by banking engines, even when they are already double-headed and in some cases unusually heavy trains may require two banking engines.

"Crossing the Level"

Our photograph shows the "Flying Scotsman," thundering over a crossing, on her run to London

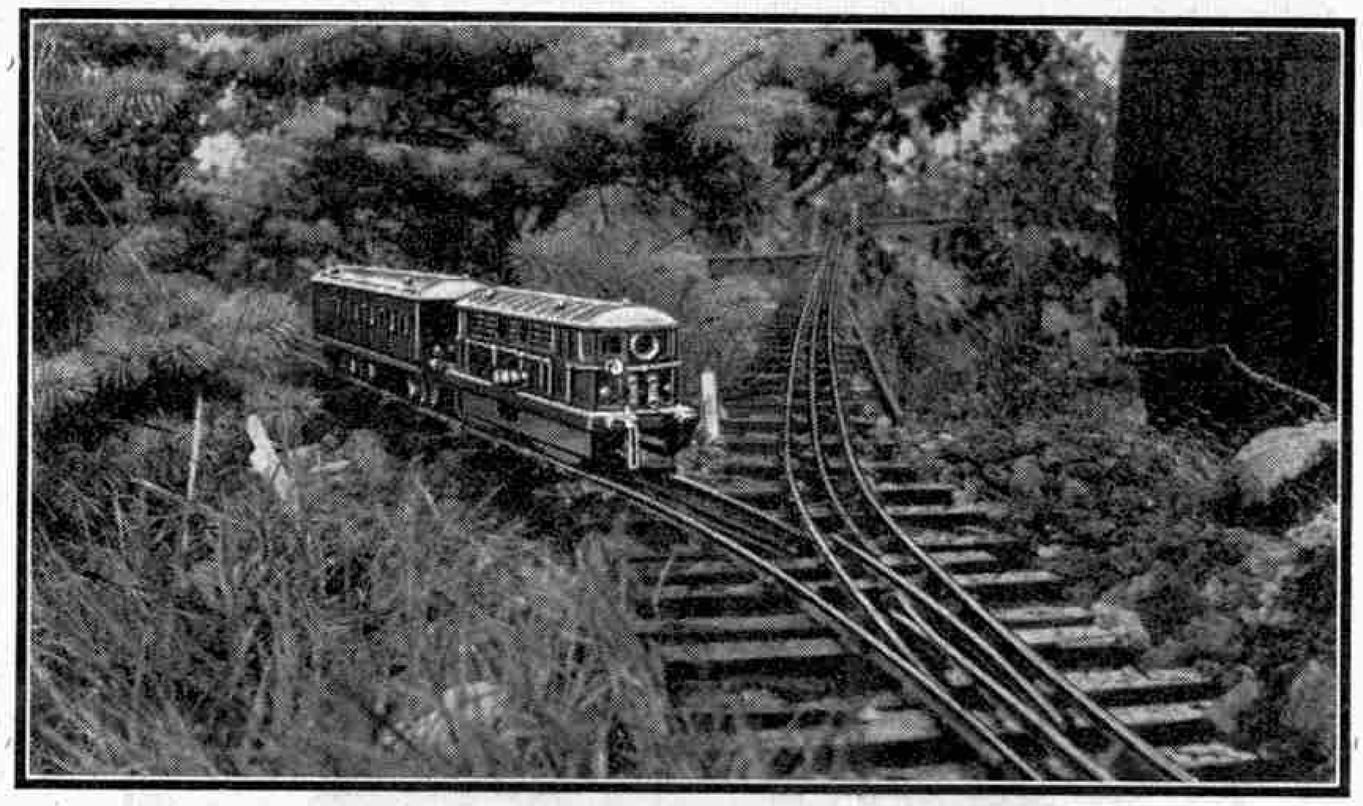
A Railway in the Garden

The Windyridge Electric Railway

By C. H. Bradnam (Bexhill-on-Sea)

THE Windyridge Electric Railway (Bexhill-on-Sea) is still in course of construction but a brief description of it in its present state may be of interest.

First of all, it is an outdoor railway. It was not originally electric and at different times both Gauge 3 and Gauge 1 were tried. Then the Hornby Metropolitan Electric Loco came on the scene and it was decided to convert the track to Gauge 0 and instal an insulated centre rail.



A picturesque scene on the "Windyridge Railway"

The accompanying sketch—which is not drawn to scale—gives a good idea of the general layout. Direct current at 220 volts is led to a shed 12 ft. by 8 ft., which houses the main station and the goods sidings. In the sketch the switchboards are shown in the shed, but these are to be moved and room is to be made for the main passenger station.

The shed is raised so that at this point the track is about 2 ft. above the ground. From here the line is carried on an elevated track supported upon tarred boards and uprights. It tunnels through a small shelter and from there proceeds to the bottom of the garden, a distance of 100 ft. Up to this point the gradient falls all the way, the average being about 1 in 40.

The line now turns on a hairpin bend of 6 ft. radius and, still falling, gradually comes down to a loop of about 40 ft. diameter. This loop is practically all at ground level. There are three points connecting the loop with the raised section of the track, as the sketch shows.

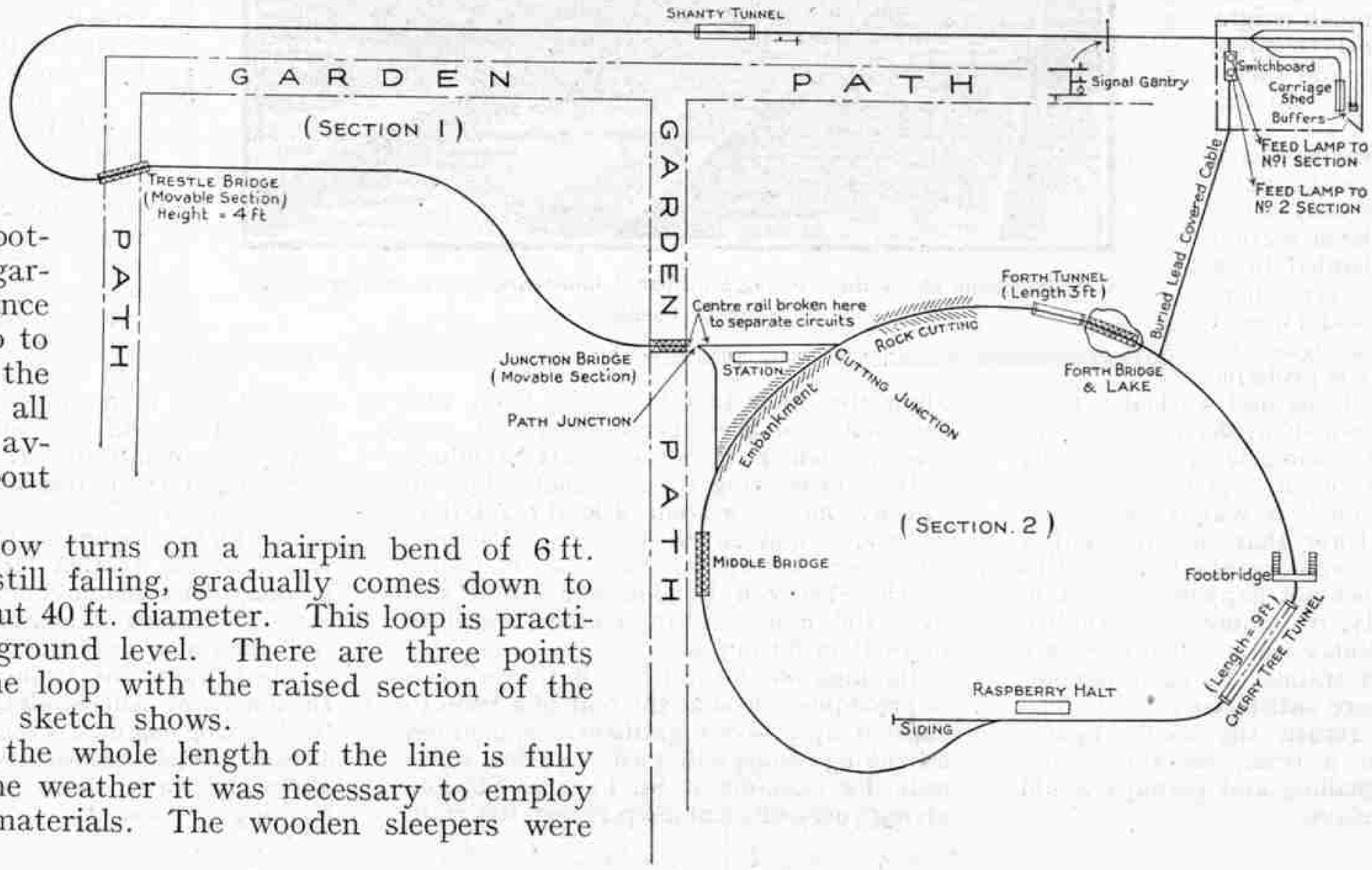
As almost the whole length of the line is fully exposed to the weather it was necessary to employ non-rusting materials. The wooden sleepers were bought in lengths of 6 ft. by ½ in. by ¼ in., cut up into pieces of the required size and dipped in tar. They were then left to "weather" and dry before being used. The chairs are of the usual composition metal and brass rail is employed.

The live centre rail is also of brass. The insulators for this rail had to be made at home as none that were suitable could be found on the market. They were made from ebonite ¼ in. in thickness, obtained from old wireless panels, and were cut ⅜ in. square. A slot for the rail to lie in was cut in each, and a screw hole was drilled and countersunk to take the screw to fix the insulator in position. These insulators were placed 1 ft. apart on straight runs and six inches apart on curves.

It may be mentioned that some of the track has been down for twelve months and is still as good as new.

There are two Meccano controls in the shed, one for the raised section and one for the loop, and lamps are arranged to act as indicators to show which section the train is on at any moment.

The points at "Path Junction" are worked by means of weight and cord from the shed, so that the train can go out and return without the operator having



to leave the controls.

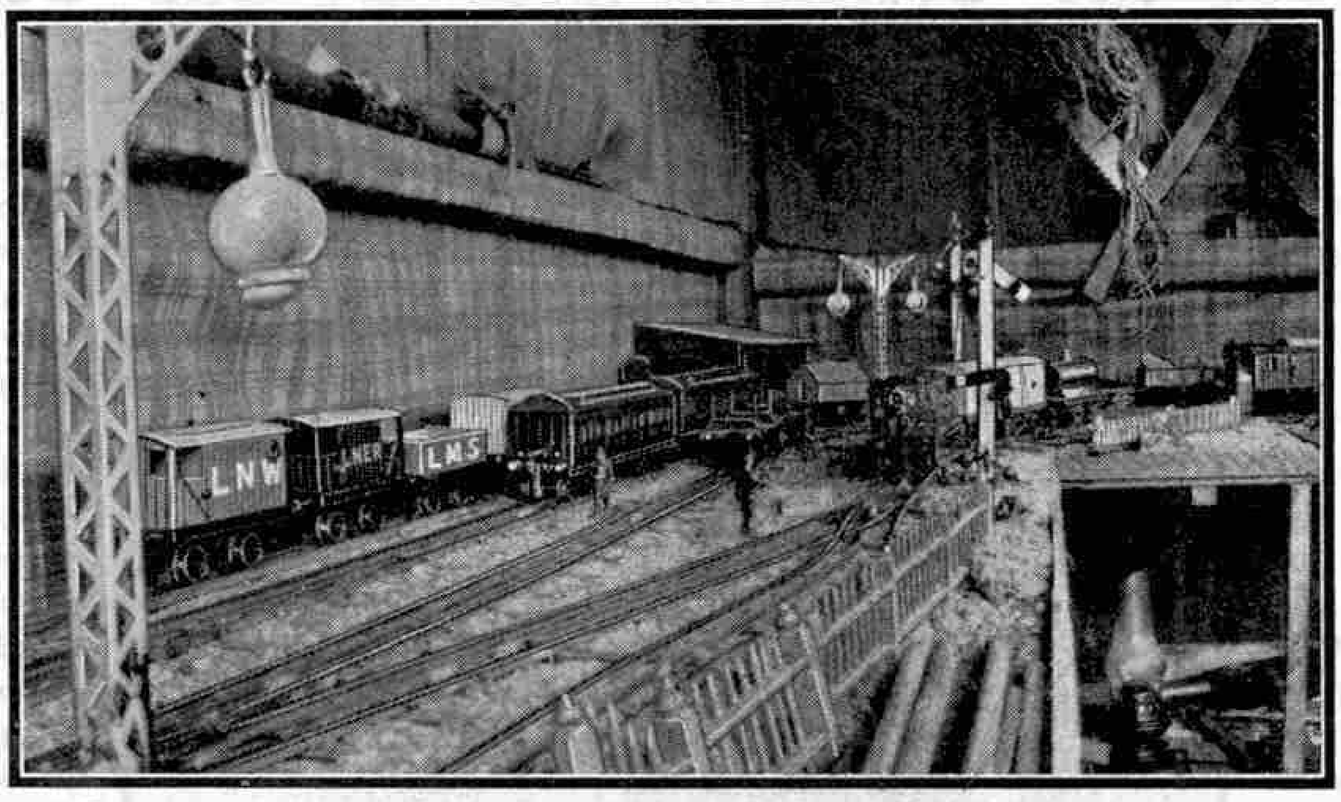
The negative (or neutral of the company's main) is earthed to the running rail and the positive goes to to the live rail. A half-ampere fuse is placed in each lead for safety.

When the Hornby Metropolitan Train is running at night around the loop, with all lights on, it presents a really delightful spectacle, and it has been greatly admired.

In addition to the train itself, the signal box and carriage shed and the signals and lamp standards (shown in the photograph of the shed) are also illuminated. The Hornby lamp standards are easily fitted for electric light by means of an ordinary pocket lamp bulb and holder, fine "flex" being brought down inside the standard.

The signals at present in use are home-made but are to be replaced by Hornby signals as soon as possible. These will be illuminated at night in a similar manner to the lamp standards, except that the bulbs will be painted over with two coats of black paint in which is scratched a small hole to allow the light to shine through a red or green spectacle.

A note here on the performance of the Hornby Metropolitan Loco will not be out of place. A test for haulage power was carried out on the loop line where the gradients are very slight. The loco hauled with ease 21 Hornby Goods Wagons, including 6 bogie wagons. In a further test it pulled 15 wagons up the steepest gradient of the track—1 in 24. In the writer's opinion there is no Gauge 0 electric loco on the market capable of equalling this performance.



The Shed, containing main station and goods sidings. The track is ballasted with "chicken grit," which is effective and cheap

In conclusion it should be added that the next step towards the completion of the Windyridge Electric Railway will be the installation of the Hornby Control System. This will greatly facilitate the operating of the line on sound railway-like principles.

Tunnelling through Ben Nevis

(*Continued from page 355*)

feature, since projections must be removed and holes filled with concrete. It is possible to blow the bench up using three holes, but the tunnel shape suffers.

Another precaution arising from the necessity for a good shape is to drill in the line of the tunnel, except cut and easers. The foreman is driven almost to distraction by men who, to save trouble in rigging their drills, make holes whose ends go feet above and outside the true tunnel shape. Of course, a drill is not easy to manipulate owing to its weight, some 120 lb., while the arm on which it is clamped weighs about 80 lb. A man's unwillingness to slide the arm bearing the machine and clamp a few inches up the column in order to get the correct position is thus quite understandable, though not to be countenanced.

The Drills and Their Work

In spite of their weight, the drills have a wonderful range of movement. The machine runs in a cradle and has a longitudinal movement of 2 ft., being propelled by a screw thread. The operator, once his position is correct, merely rotates a handle at the back. The attachment to the arm is by means of a clamp that allows rotation of the cradle, and the clamp can rotate on the arm so as to point the machine up or down. The arm is able to slide through another clamp fixing it to the column and the column clamp can, of course, be fixed anywhere on the column. The lower end of the column has a screw thread and collar so that the column may be tightened up and made immovable against wood blocks and wedges on floor and roof.

The "human rig" beats the mechanical hollow. A drifter (drill) with handles attached is laid on a plank so as to direct the steel into a lifter. The driller sits on a plank with his feet against the handles and his spannerman or helper sits with his back against the driller's and pushes for all he is worth. As the handles are well sprung, this process is little more uncomfortable than riding a powerful motor-cycle, which indeed it closely resembles. The general use for a machine with handles is shaft sinking, where all the holes are vertical or nearly so and the weight of the machine helps in the drilling.

"Chipping" is really a more accurate term than drilling, for a rock drill works on the chipping principle. The bit is usually star-shaped, that is it resembles two cold chisels at right-angles to each other, and through the drill steel runs a hole. Inside the machine is a pneumatic hammer and a device for giving the steel a slight rotation at each blow. Water flows continually down the steel and keeps the bit cool, lessens dust and washes the chippings from the hole.

It is unlikely that any other form of power than pneumatic will ever be used for this purpose. Electricity is out of the question because of the terrible ill-usage and vibration; water is impossible on account of drainage questions and steam because of the noxious exhaust. Air is a first-class ventilator and ventilation is of the greatest importance.

Wearing Away of Bits

The rough usage given to a bit soon reduces its size. In a 2 ft. length of hole drilled the bit may be worn away from $2\frac{1}{2}$ in. to $2\frac{3}{8}$ in. This means that the drills to start with must be, say, $2\frac{1}{2}$ in. across the bit, and after boring for 2 ft. must be followed by a longer steel measuring $2\frac{3}{8}$ in., this in turn being followed after 2 ft. by one of $2\frac{1}{4}$ in. This gauging of the bits varies with different types of rock. The last drill used in a hole must not be so small that the gelignite will not go in.

The steels are sharpened, after being heated in a fuel-oil furnace, by a process of "bashing" the star-shape on with a correctly-shaped pneumatic hammer; then bashing the webs and finally bashing the edges of the webs so that the gauge is correct. By this time the first bashing has been spoiled a little so the process is repeated, the drill being re-heated and then plunged into a water bath to temper it. An inexperienced driller will sometimes use a steel after it has lost its usefulness and we then see the phenomenon of a steel whose bit has no trace of the original star.

(*To be continued*)

The Lonely Island of St. Kilda—

(*Continued from page 337*)

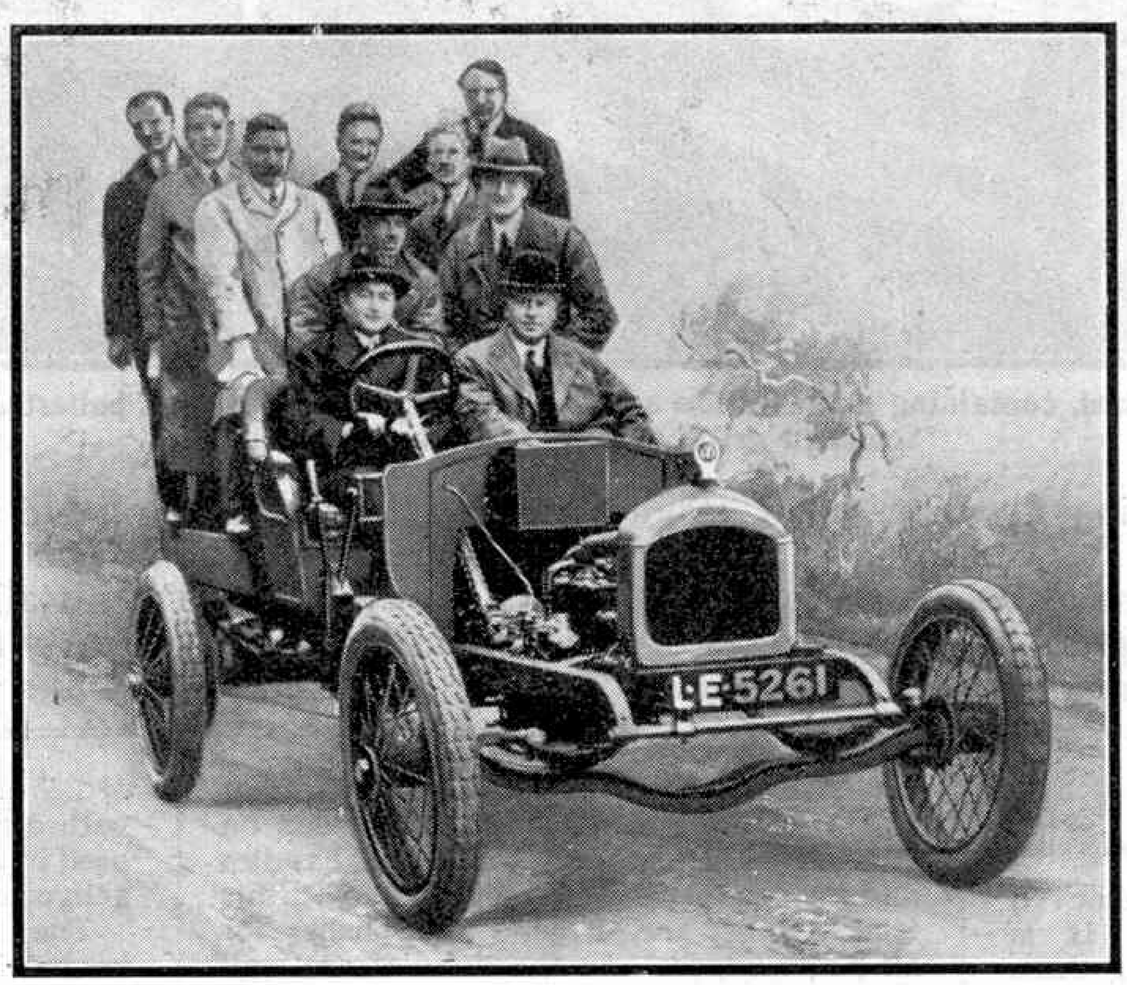
boat to forward the letters to their destination, coins being enclosed for postage. A lid is then tightly nailed over the hollow in the miniature mail boat, which is attached to an inflated bladder made of sheepskin and thrown into the sea when a westerly wind is blowing. Some of these little mail carriers are never seen or heard of again, but the majority of them reach the shores of one of the Hebridean islands or of Norway, and are picked up and their contents forwarded. Our illustration showing the launch of this quaint mailboat is reproduced from Mr. Kearton's book, "*With Nature and a Camera*," by permission of the author.

The illustrations of cormorants and guillemots are taken from "*The Pocket Book of British Birds*," and are reproduced by courtesy of the publishers, Cassell & Co. Ltd., London.

Motor Cars Without Gears

Success of the Constantinesco Torque Converter

SOME of our readers may remember that three years ago we dealt with a remarkable invention, the Constantinesco Torque Converter. This invention, which we described as being "an invention of promise," was then more or less in an experimental state. Now it has been applied in a practical manner to motor-cars, six of which, fitted with the device, were last year exhibited at the Paris Motor Show, three in the Grand Pallais and three outside giving demonstrations to the public. During the time of the Motor Show at Olympia, these cars were exhibited at Devonshire House, and are now shown at the Constantinesco Laboratory, 130, Wilton Street, S.W.1, near Victoria Station.



The first car to be fitted with the Torque Converter. Driven by a 10 h.p. engine it was tested successfully in May 1923

The Torque Converter is the invention of Mr. Constantinesco, a Roumanian engineer who did a great deal of useful work in this country during the war. Many inventions stand to his credit and perhaps the best-known of all is the high-speed timing apparatus for machine guns, by means of which 2,000 rounds per minute may be fired through aeroplane propellers revolving 1,500 to the minute. This invention, which at once made the Allies' aeroplanes immensely superior to the Germans, was fitted to over 40,000 British and to many thousands of American aeroplanes.

The practical application of the Torque Converter to motor-cars is of such interest, and the invention itself of such far-reaching importance, that we think our readers will be glad to have full details of it. More especially so as the Converter has now been included in our "Standard Mechanisms" Manual, because we believe that there are numerous applications of the principle to Meccano models.

Before describing its application to motor-cars, which application will eliminate the use of the ordinary clutch and gear-box, it is desirable to explain the principle on which the Converter depends. In this connection it may be mentioned that Mr. Constantinesco told the writer that without falling back on advanced mathematics and highly technical engineering knowledge, it is impossible for him to explain how the results are obtained so that the non-technical reader could understand. If the inventor himself finds it impossible to give this information, our readers will readily realise that the writer is confronted by a task of some difficulty! However, a Meccano model of the Converter was built some little time ago and it remains to-day the only practical means by which the non-technical reader can understand how the Torque Converter functions.

Before we go on to describe the construction and working of this model and later see how the Converter is applied in actual practice, we will endeavour to convey some idea of the working principle underlying the device.

The majority of mechanisms used for the purpose of power transmission are direct or indirect applications of the principles of the lever, as demonstrated by Archimedes. The principle of the Torque Converter throws a new light on the classical boast of the famous Greek mathematician—that he "could lift the world if he were given a fixed point." If this is taken to mean that given a suitable lever and a fixed point, a small force can produce as big a force as required, then the Torque Converter fulfils this interpretation. It has this essential difference from the ordinary lever, however, that a fixed point is no longer necessary for its applications—although this does not enable it to be applied to lifting the Earth!

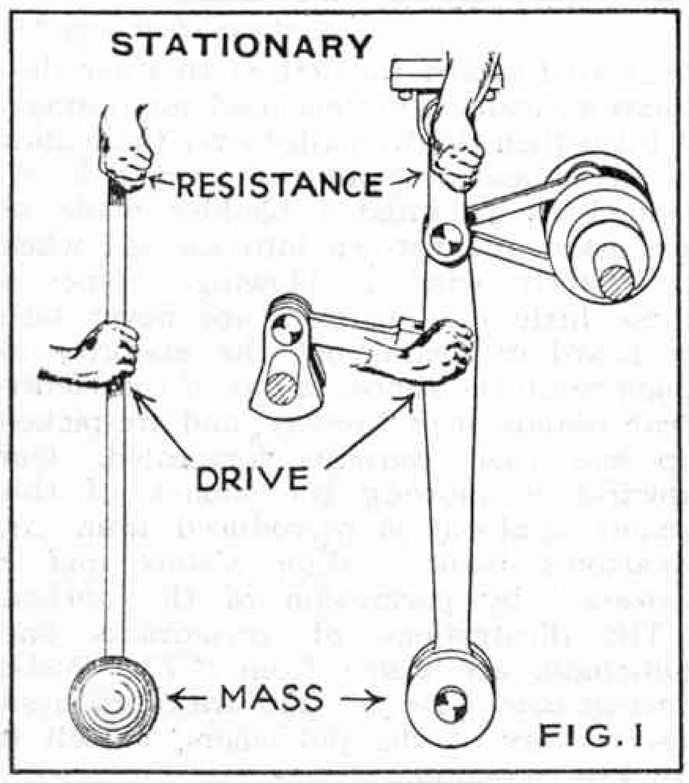


FIG. 1

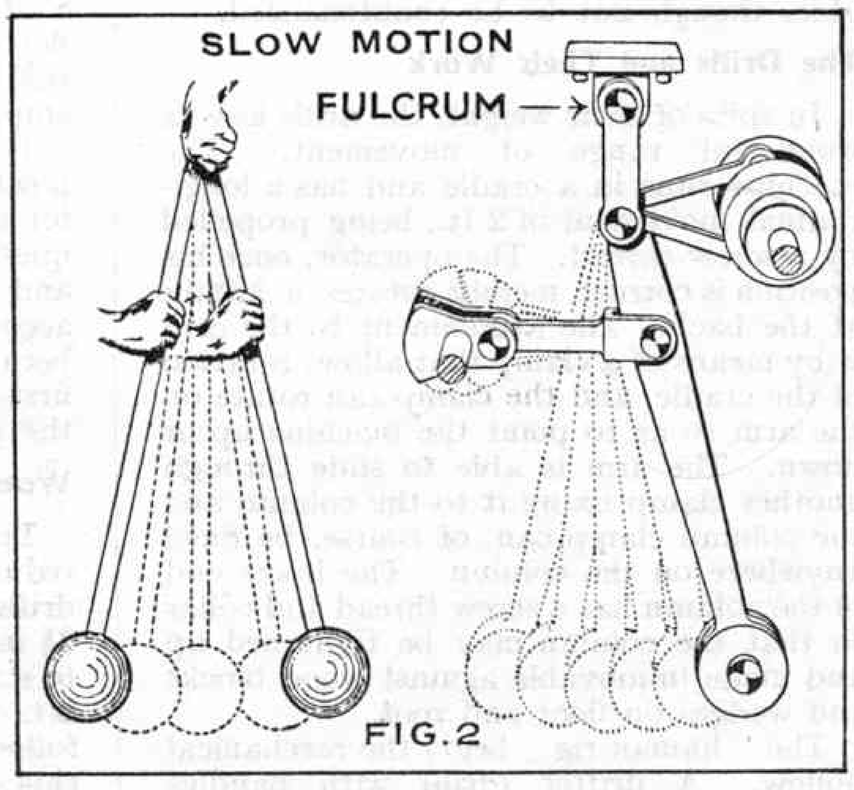


FIG. 2

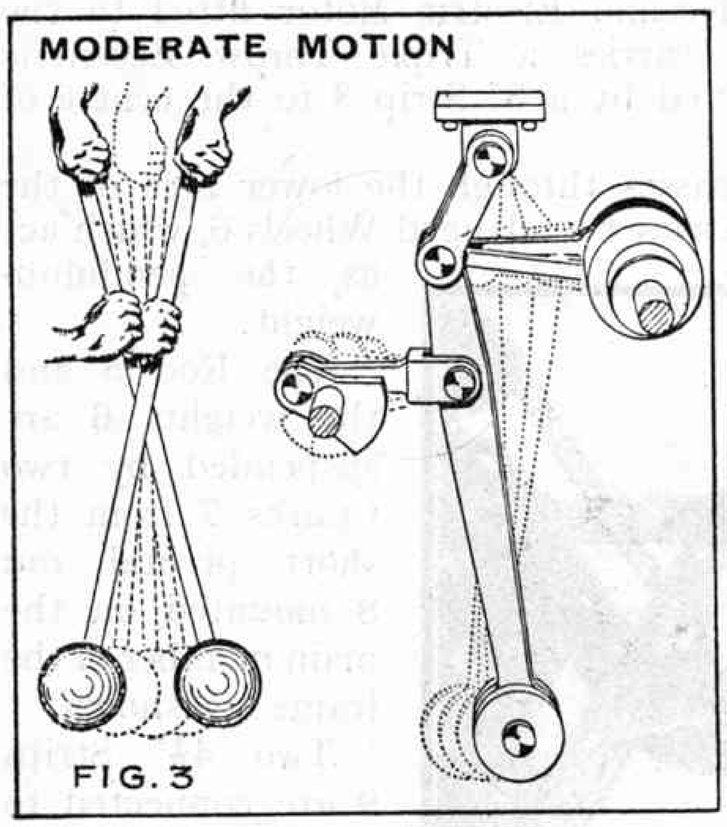


FIG. 3

The ordinary rules of static mechanics do not apply to the Torque Converter, and it is only by the consideration of the elements "Time" and "Mass" that the behaviour of the Converter can be explained. As has already been mentioned, for a complete understanding of its working mathematics of a high order are required.

The invention may be described as a practical illustration of the principle of Relativity applied to the all-important problem of automatic transmission. We are here sailing in rather deep waters, however, but we will endeavour to obtain a rough idea of what it is all about from a simple analogy by means of a walking stick with a heavy knob. This stick is held by the right hand suspended with the knob downwards and held by the left hand a few inches below the tip. On swinging the stick gently to-and-fro it is noticeable that the stick swings easily, pivoting in the thumb and finger of the right hand. This easy and pendulum-like swinging of the stick continues as long as the impulses given to it by the left hand are not excessive. If the frequency of the impulses be increased, however, a different state is set up. This is evidenced by an increase in pressure conveyed to the right hand that is acting as a pivot for the stick.

As the impulses increase in frequency a change in equilibrium takes place, so that instead of the stick tending to pivot between finger and thumb of the right hand, the pivot shifts down the stick At length, given a sufficiently high-frequency, the pivot moves to the opposite end of the stick and the knob becomes the pivotal point, whilst the pendulum-like movements are carried out by the hand in which the stick originally pivoted.

The original conditions have thus become entirely reversed. Instead of the knob oscillating to-and-fro and the right hand remaining at rest, with the tip of the stick pivoting in the finger and thumb, the knob ceases to oscillate and becomes the point upon which both stick and supporting hand now pivot. The oscillations originally performed by the knob are transferred to the other end of the stick and are now performed by the right hand. Expressed in engineering language, the technical term would be that the fulcrum has receded.

To the person holding the stick this change is made manifest in a very remarkable manner. As the impulses increase in frequency, the hand holding the tip of the stick finds itself compelled to yield to an irresistible increasing pressure. It is moved backwards and forwards by a powerful superior force, oscillating this way and that, with a degree that depends entirely on the frequency and amplitude of the impulses received by the stick.

It is important to realise that the pivotal point does not change suddenly from the tip of the stick to the knob, but moves slowly from one to the other, according to the frequency of the impulses received by the stick. If these are not sufficient, the fulcrum need never reach the knob. If the frequency varies, the position of the fulcrum will vary also every instant, its location alternating momentarily between the tip and the knob. If the oscillations decrease in intensity beyond a certain point, the pivotal point returns to the tip and the original order of things is restored.

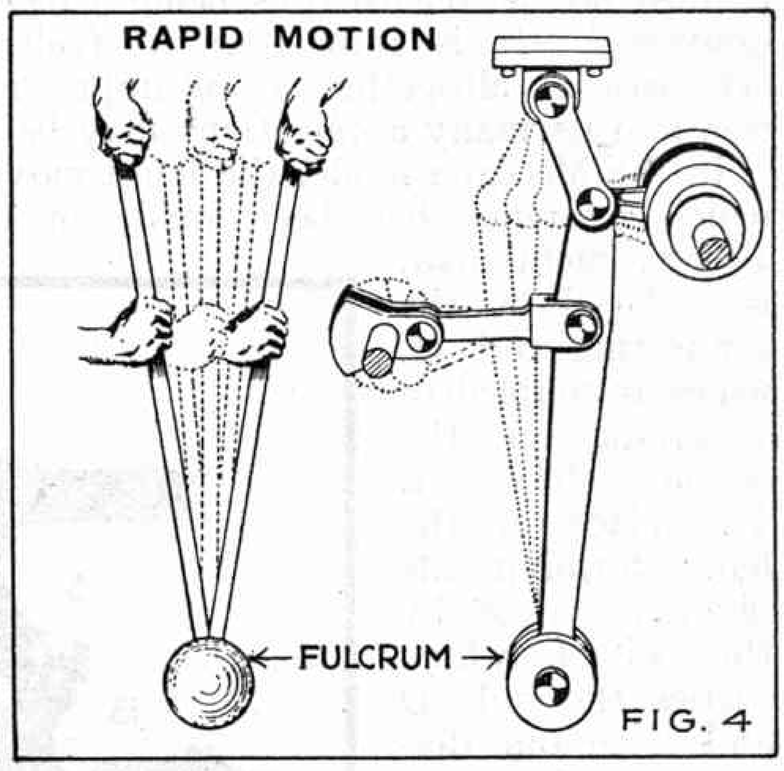


FIG. 4

In the accompanying illustrations (Figs. 1–4) are shown four phases of a simple experiment that may be performed by two persons standing at right angles to each other, and with the stick with a weighted end. Alongside these, on the right of each figure, are illustrations showing how the Converter itself would function in positions corresponding to those of the stick. In these latter illustrations the lower hand is replaced by a connecting rod moved by a crank, and the upper hand by two unidirectional devices, connected to the secondary shaft at the point where the resistance occurs.

It will be observed that a slow oscillatory motion (as in Fig. 2) merely serves to swing the pendulum to-and-fro, during which time the fulcrum of oscillation remains at the point of resistance. When the oscillatory motion at the drive is increased, however, it overcomes the resistance, and the fulcrum automatically comes down to some intermediary point, as shown in Fig. 3.

An even more rapid oscillatory motion, applied at the drive, causes the inertia of the knob to oppose the motion, and the resistance is completely overcome. The power hand has then no option but to move as if it were driven directly, the fulcrum being now at the bottom of the stick and in the pendulum knob (Fig. 4).

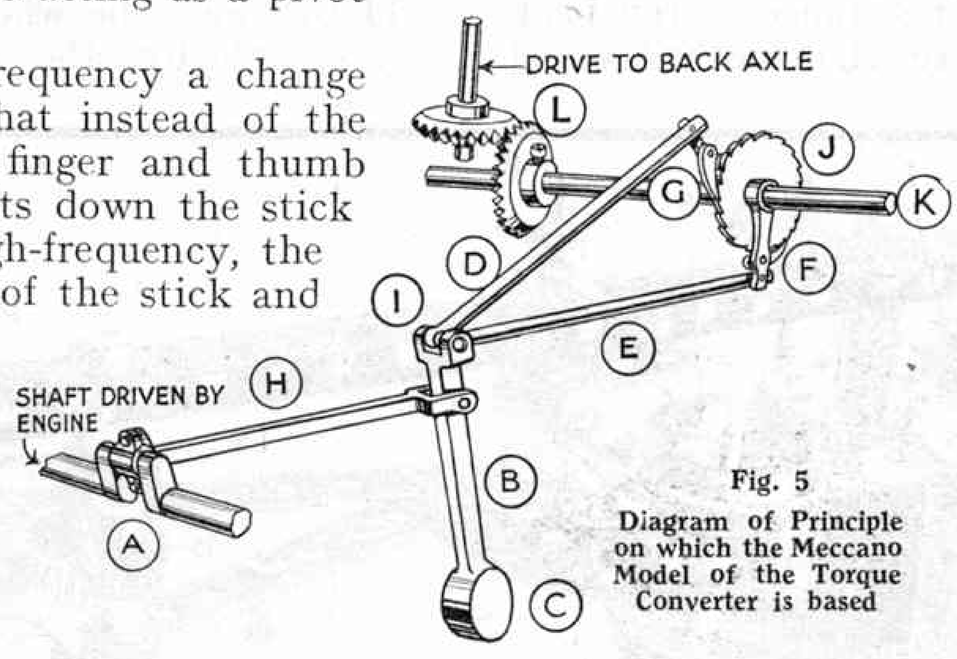


Fig. 5
Diagram of Principle on which the Meccano Model of the Torque Converter is based

The Converter in Meccano

To pass on to the Meccano model, from a study of which a clearer idea of the Converter will be more easily obtained than by a perusal of any number of lengthy explanations in print.

The principle on which the Meccano model is based is demonstrated in Fig. 5, and it is desirable that this diagram should be closely studied, and its points of analogy with the real Converter thoroughly understood. It cannot be too strongly emphasised that the Meccano model is simply a demonstration of a principle, and

it must not be regarded as being a model of the actual Converter. It is important to realise this, because otherwise an altogether wrong impression of the invention and its many applications may be obtained.

In the Meccano model the hand moving the stick, to which reference has been made in the experiments already mentioned, is replaced by the connecting rod H, which is coupled to a crank on the engine shaft A. The place of the hand forming the pivot is taken by the bolt I, which carries the rods D and E in our diagram. Impulses from the crank A are transferred by the pawls, F and G, to the toothed-wheel J, which in turn passes on the impulses—now converted into a turning movement—to the driving shaft K and so to the road wheels through the bevel gears L.

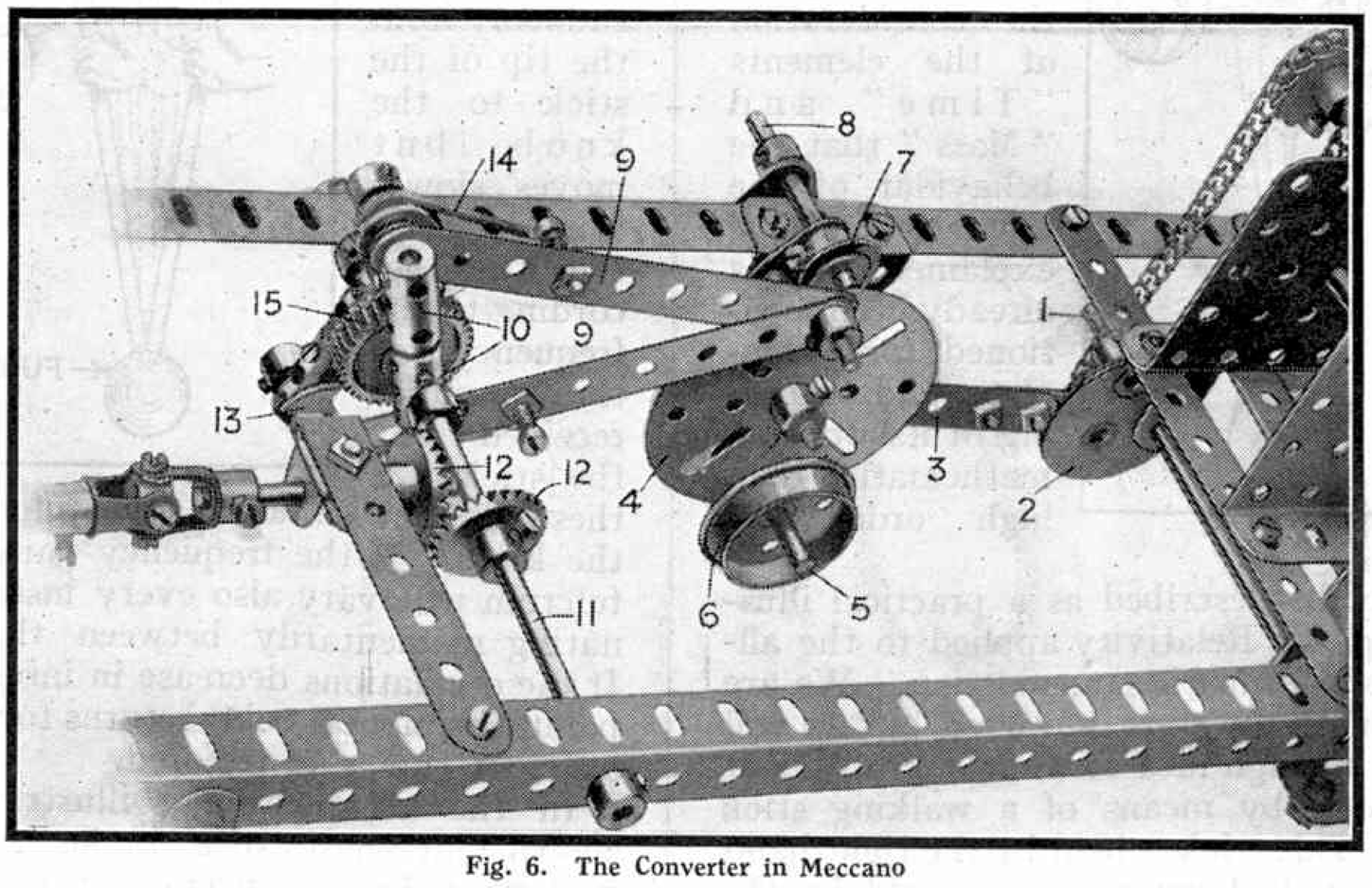


Fig. 6. The Converter in Meccano

When the engine is running slowly only a slight swinging movement is given to the lever carrying the weight, which movement is not sufficient to move the pawls on the toothed wheel J. As the speed of the engine increases, however, the weight is compelled to swing faster and faster, imposing an increasingly heavy force or load upon the pawls. At length this load becomes so great that the resistance of the back axle is overcome, the pawls move the toothed wheel and therefore vibrate the driving shaft, and the car moves forward.

The conditions of the analogy in Fig. 1 are simulated when the weight C in Fig. 5 swings without imparting any movement to the shaft through the pawls and toothed wheel. On the other hand, when the engine is running rapidly the fulcrum recedes and the weight C becomes the pivot, as it cannot respond to the rapidly-repeated impulses of the rod H with sufficient rapidity.

The condition illustrated in Fig. 2 arises when the resistance caused by starting up the car is overcome, and when the lever pivots on the weight C. In these circumstances the drive from the engine is practically a direct drive to the back axle.

The Construction of the Meccano Model

Turning now to the actual construction of the Meccano model. The rod 1 (Fig. 6) is rotated by a sprocket chain from the Meccano Electric Motor fitted to the chassis. The rod carries a Triple Throw Eccentric 2, which is connected by a 3" Strip 3 to the centre of a Face Plate 4.

A short rod 5 passes through the lower hole of the Face Plate and carries two flanged Wheels 6, which act as the pendulum weight.

The Rod 5 and the weights 6 are suspended by two Cranks 7 from the short pivotal rod 8 mounted on the main member of the frame as shown.

Two 4½" Strips 9 are connected to the top hole of the Face Plate 4 and their other ends are connected to elements, each formed by two Couplings 10, secured on the short rods. The Couplings rock loosely on the driven rod 11, from which the drive to the differential is conveyed through the bevels 12.

The Pawls 13 are mounted on short rods secured in the outer holes of the Coupling (shown more clearly in Fig. 7), these Pawls being controlled by short tension springs 14 so that they are kept in contact with a 1" Gear Wheel 15. When moving in one direction, they drive the Gear Wheel 15 and consequently the rod 11 to which the wheel is secured.

Technically, the theory of the mechanisms is as follows: — When the Electric Motor is running slowly, the pendulum tends to oscillate about the rod 8 and little, if any, movement is imparted to the Pawls —a state corresponding to a low power. Should the resistance to movement in the rear axle be great, however, the fulcrum recedes towards the weight 5. Owing to the inertia or reluctance to vibrate quickly the Face Plate then pivots about the weight and a greater force is exerted on the Strips 9 to drive the Shaft 10. In this way the gear accommodates itself automatically to the work to be done.

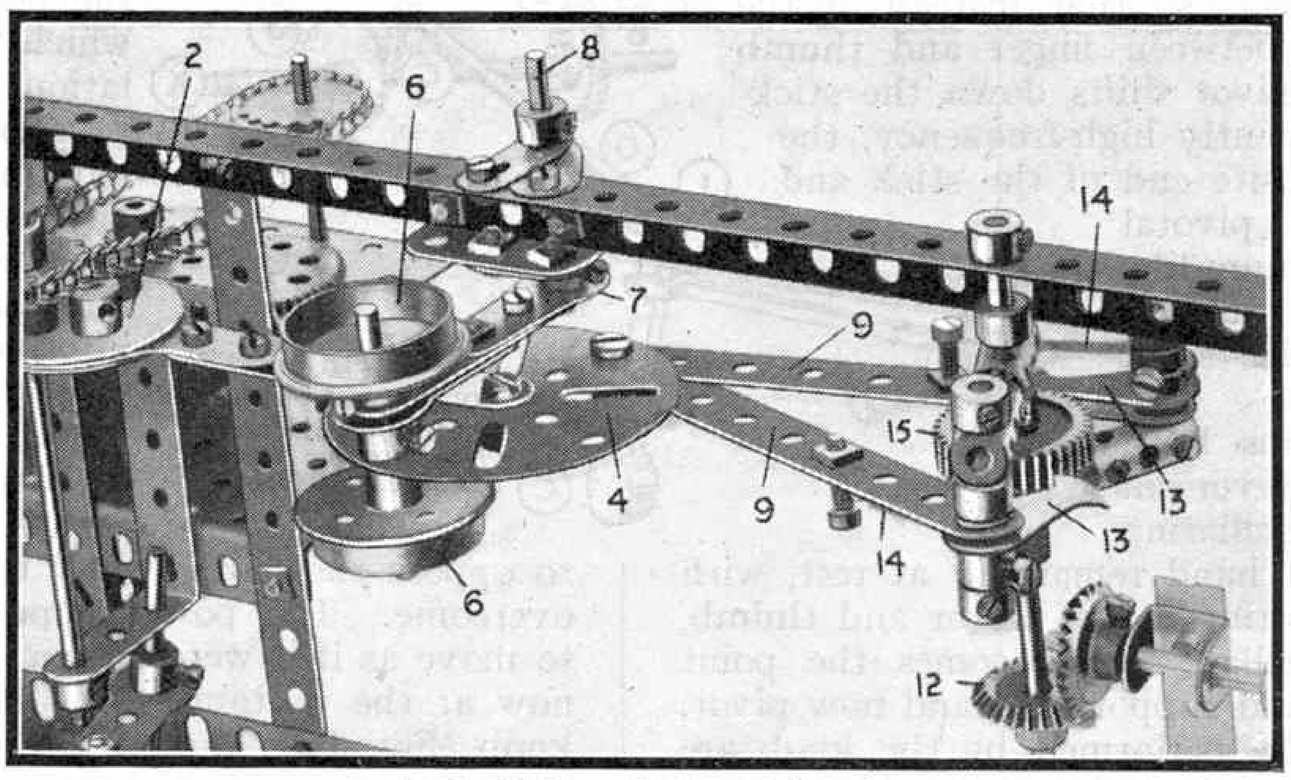
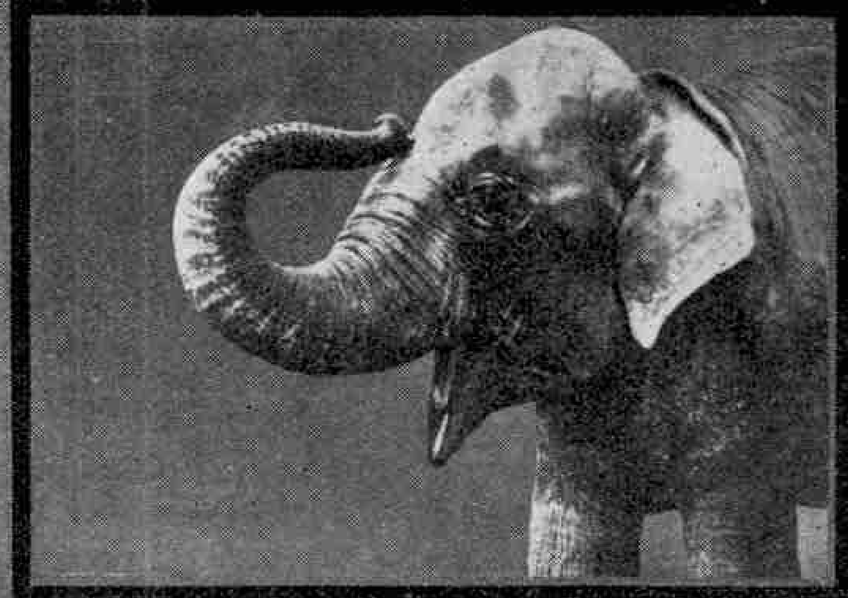


Fig. 7. Underneath View of Converter

In operation the Rod 1 is rotated by the motor, the Eccentric 2 tends to drive the Strips 9 to-and-fro as the weight oscillates. This to-and-fro movement of the Strips 9 results in a corresponding movement of the Pawls. As the Pawls are mounted to lie in opposite directions around the Gear Wheel 15, the latter is driven in one constant direction in a series of pulsations.

(*To be continued next month*)



ZOO NOTES

120 Specimens for the London Zoo from West Africa

Sir Cecil Armitage, the Governor of Gambia, West Africa, recently presented to the London Zoo a large and valuable collection of animals and birds, which were brought to Liverpool on the S.S. "*Accra.*" A native boy came over with the animals from Bathurst, the capital of the colony, but he is returning to Africa as there is not enough sunshine for him in England!

Great care has to be observed in handling animals that are brought to England from the tropics. Little trouble is experienced on board, as the sea appears to act as a stimulant to the animals, but casualties are liable to occur as soon as the ship comes into port. In order to prevent deaths due to cold the animals must be removed immediately to the specially-heated railway vans in which they are to continue their journey to London. On this occasion the collection was promptly taken in hand by Mr. W. H. Mills, the Liverpool agent of the Zoological Society of London, and he lost no time in despatching the creatures to their destination.

There were 48 cages containing 120 specimens, including an alligator, ostriches, chameleons, monkeys, antelopes, jackals, and many other animals and birds. Particularly timely arrivals in the consignment were two serval kittens, as Ching, the well-known specimen in the cat house, died of pneumonia in the cold weather. The ostriches were three in number, and these had to be sent to London in a special van normally used for motor cars, as their height was about 7 ft. 6 in.

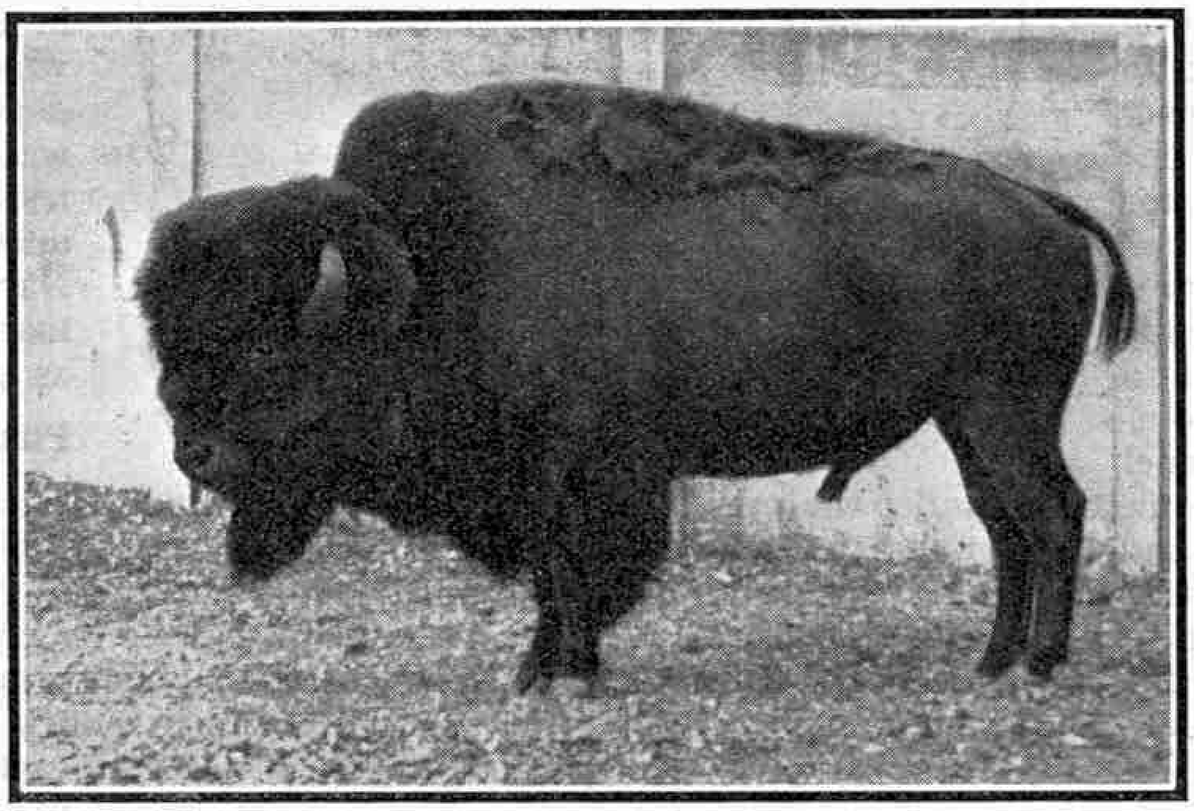
* * * *

Proposed New Zoological Park

The Zoological Society of London propose to establish a home for wild animals at Whipsnade in Bedfordshire. For this purpose more than 400 acres of land have been bought and the intention is to develop the estate as a sanctuary for British birds and plants and ultimately as a general zoological park. It will serve also as a recuperating and exercising ground for animals from the London Zoo. The estimated cost of the scheme is about £200,000.

Strange Companions

Efforts to find a suitable companion for Pongo, the London Zoo's baby orang-outang, have led to some curious results. At first he lived with the young chimpanzees, but as he did not join in their fun they soon grew tired of him and he had to be taken away. Even the older orang-outangs could not induce him to settle down, and he came to be regarded as hopelessly unsociable and was left to himself. But a tree kangaroo was put into his cage on arrival at the Zoo, owing to lack of space, and after watching this strange animal—a true kangaroo from New Guinea that lives chiefly in trees—Pongo struck up a friendship with him. The two are now great friends, sleeping in the same box and sharing their food.



This photograph, taken by J. G. Cheshire, a member of the Cranham Meccano Club, shows one of the American Bisons at the Zoo. Bisons were nearly exterminated by hunters in America, but are now protected by the U.S. Government

* * * *

A Pugnacious Alligator

George, the well-known alligator at the London Zoo, has been annoyed on two recent occasions because an unfortunate animal sharing his home refused to stay in one corner of the pond. On the first occasion it was a relative that caused the annoyance, and in the ensuing fight George was successful in putting an end to his adversary's career! The last time it was a crocodile that did not behave itself, and George was not so successful. Nevertheless the crocodile received a severe bite on the head and the wound bled for three days.

An Electric Fish

The London Zoo aquarium recently acquired a number of specimens from Madeira, including vividly coloured wrasses, or "jazz fish," and puffer fishes that rival the tortoises mentioned in our February number at "getting the wind up!" The most interesting of all, perhaps, is a young electric ray. This strange fish is provided with an organ resembling an electric battery that is capable of giving very severe shocks indeed, and in its native haunts it uses this power to defend itself, or to stun or kill the smaller fishes on which it feeds. A shock is received when two points on the surface of the fish are touched, completing an electric circuit.

The shock is truly electric, for it has been found that the currents that produce it possess all the other known properties of electricity, such as affecting a magnetic needle or giving a spark, and there is no difficulty in lighting a small electric lamp from the fish now at the Zoo! It is interesting to note that the ray was used to cure rheumatism by giving electric shocks long before anything was known of the nature of electricity or the voltaic battery.

* * * *

An Ultra-Violet Rays Tragedy!

The long winter months so depressed the spirits of a squirrel monkey at the London Zoo that he was sent to undergo ultra-violet ray treatment. The treatment was no less successful in this case than in that of "Murphy," the orang-outang, whose improvement in health showed itself in the growth of a new crop of hair as mentioned in our January issue.

The results with the squirrel monkey were more startling, however. For about a month all went well. Under the influence of the rays the little creature recovered his spirits and showed greatly improved health, but one morning his liveliness took the form of jumping out of his cage when the door was opened by the keeper for feeding purposes. He rushed out into the gardens and finally escaped, and in all probability he has succumbed by now from exposure to the cold. This unfortunate tragedy demonstrates the remarkable effectiveness of ultra-violet ray treatment but also shows it is not free from danger.

Tunnelling through Ben Nevis

The Lochaber Water-Power Scheme

By Thomas Blench

SO much has been written about the 16-mile tunnel through Ben Nevis from the point of view of the casual visitor that it is time readers of the "*M.M.*" heard about it in detail, from an engineer actually on the job.

First of all, in regard to the scheme itself, all that it is necessary to know is that Loch Trieg—please refer to a map, preferably one showing contour lines—is a good natural reservoir, and that Fort William is a port convenient for Ireland from where aluminium ore can be obtained. Consequently the British Aluminium Company have decided to take Loch Trieg water to Fort William, let it fall some 500 ft. down iron pipes laid on the hillside, into turbines, and use the power thus generated to produce the electric current necessary for the electrolysis of the ore.

In a country of mountains and precipitous valleys a pipe line is out of the question, and a tunnel provides the only solution of the problem. The tunnel under consideration starts some 80 ft. under the present Loch level and follows in straight sections the general line of the 600 ft. contour line. It begins at the extreme north end of Loch Trieg and finishes about 600 ft. up the hill slope, two miles due west of Fort William Station, and two miles from the peak, Ben Nevis.

Wild and Rugged Country

The country is cut up by deep valleys bordered on one side by sheer rugged rocks and on the other by gentler grass slopes. The streams are almost dry in fine weather but a few hours' heavy rain transforms them into seething torrents carrying all before them and depositing the adit tips hundreds of yards down-stream. Then the unwary engineer may find his tip rails suspended over the waters or, worse still, lying convulsed in a spray of dancing foam. The wind, too, is boisterous and will soon transport a badly-stayed hut or overturn a digger. Its force down below, however, is nothing when compared with its fury in the domain of the ptarmigan and the eagle, where it sweeps the hilltops clean so that only little flat stones are left to show its path.

Through the heart of this wild and beautiful country the tunnel must be driven, and it will be interesting first of all to review the considerations that determine the tunnel's position and the points at which it shall be attacked, for naturally a tunnel 16 miles in length must be tackled at more places than its ends.

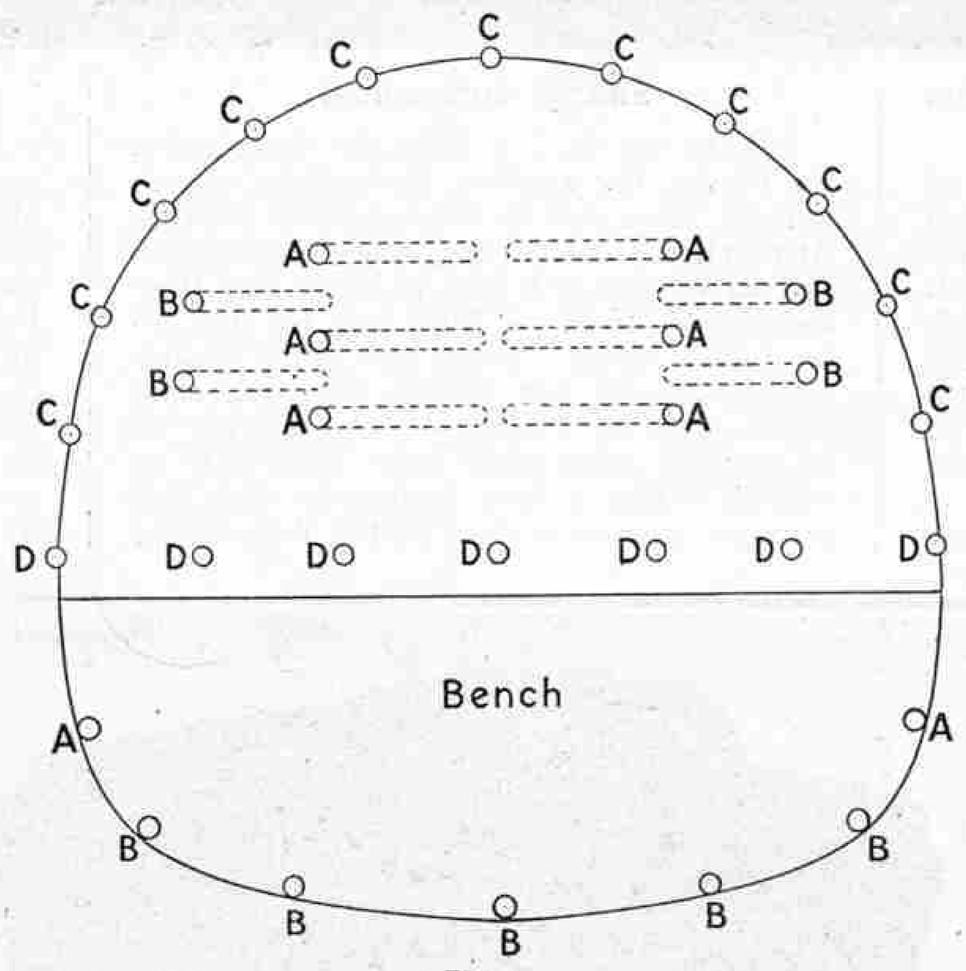


Fig. 1
Diagram to illustrate Drilling and Firing

It must not be too far in the hillside all the way or it will be difficult to tunnel into it, and on the other hand it must not be too near the surface or its direction will be continually varying in order to dodge valleys, thus necessitating a longer tunnel and more expense in every way. The height at which the tunnel is to come out depends upon the height of water required to overcome friction in the tunnel and produce a practical speed of flow. Naturally, every endeavour is made to have the available fall as great as possible.

Planning the Tunnel

The question of points of attack is also answered by a compromise. It is desirable to commence the tunnel at many points in order to get it completed quickly, but every adit or shaft is so much excavation that will be useless after the job is complete, so it is not desirable to spend too much money in this manner. The only thing to do is to obtain a rough idea, from the results of the preliminary survey, of where entries are desirable, and to estimate the cost. Several schemes are then considered and the best chosen, after which points of attack are fixed definitely on the ground.

Obviously the best positions are on streams, because there is then a water supply for the pneumatic drills, the compressors and the camps, not to mention the concreting after the tunnel is excavated. Moreover, at a stream the tunnel will be near the surface of the ground for, generally speaking, the streams have cut their channels well into the hillside.

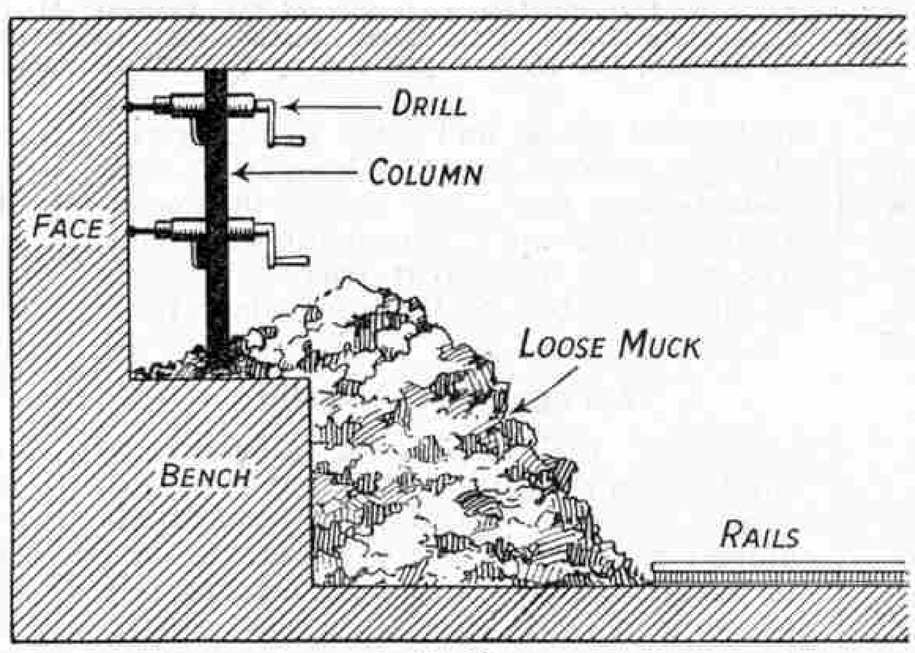


Fig. 2
Diagram of Machines at Fall (Air and Water Hoses omitted)

Adits or Shafts ?

Next, it must be decided whether to drive an adit—

a small tunnel to meet the main one—or a shaft. The ground may be such as to require an adit 2,000 ft. in length, whereas a shaft may be only 150 ft. in depth. But a shaft must have a large section for convenient working and everything from it must be lifted, involving extensive hoisting gear and the continuous item of large power expenditure. Moreover, the large sectional area brings the actual excavation cost up to a large figure. Yet another point to be borne in mind is that stores have to be brought by railway, and it is much easier to run a railroad between adit mouths differing in level by some 40 ft. than between an adit mouth and a shaft head differing by 200 ft. in the same distance. Comparing an adit 1,000 ft. by 9 ft. by 8 ft. with a shaft 200 ft. by 18 ft. by 12 ft., we see that the excavations are respectively 72,000 cu. ft. and 43,200 cu. ft. in less than a 2 : 1 ratio. In this case the shaft is a washout.

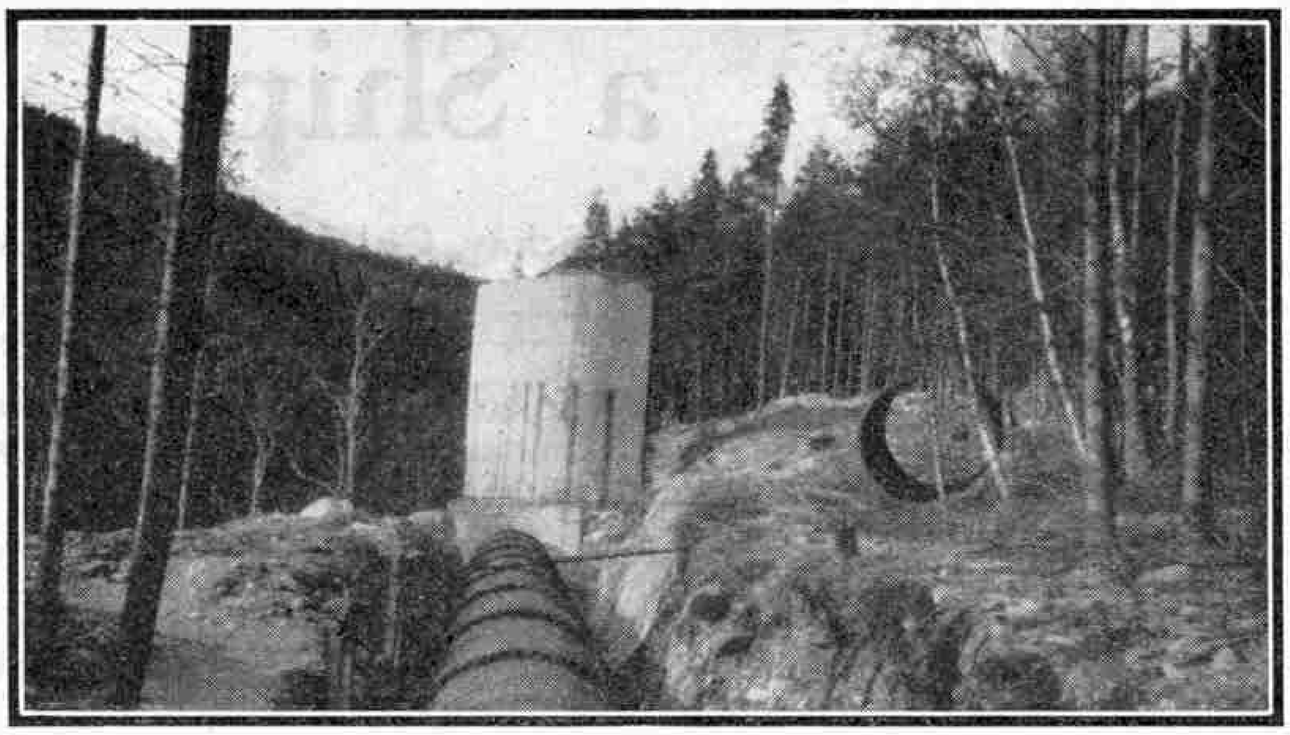


Fig. 3
Valve Shaft on Loch Trieg

One more point about starting off from a stream is that the large rivers are to be taken into the tunnel by means of small shafts, which will be driven upward from the tunnel. If these be started before much of the main excavation has been done they will act as ventilators. These minor shafts or intakes are about 8 ft. by 6 ft. and will eventually contain two pipes, one for taking the water from a small dam on the stream and the other for allowing air to escape from the water.

Apart from the two ends of the tunnel, work is being carried on at ten intermediate places, spaced at intervals of roughly two miles along the contractor's railway, and it is to be hoped that all the little bits of tunnel will meet their neighbours at about the same time because this means the completion of tunnelling in the shortest possible period and at the lowest possible cost.

Now that we have had, as it were, a run over the job, we can pay a visit to one of the adits and see how things are done.

Operations at the Adits

Without paying attention at present to the many buildings containing compressors, drill-tempering furnaces, stores, etc., we shall see how the boring out of the tunnel is accomplished. The shape is as shown in the diagram, Fig. 1, and the height is about 16 ft. The whole place is very rough and jagged but the true shape is very easily seen. If we are lucky we shall find at the working face four machines rigged on arms projecting from two columns and ready to drill the top semicircle that is painted on the rock, the engineer being responsible for the semicircle being in the right place. The foundation for the machines is a bench of rock, which is always left for that purpose, and a lot of broken stone from the previous firing. The arrangement is shown diagramatically in Fig. 2.

All that now remains to be done is to drill the holes in the face while the "muckers" are clearing away the shattered rock, loading it into skips that are drawn by electric locos out to the tip, via the adit, and emptied there. Mechanical "muckers" are now being employed successfully but they cannot be used all the time because a path has to be cleared for them and they cannot scrape the bench clean. Once the bench is clear, a few holes are placed under it and it is ready for blasting.

Method of Blasting

Referring again to Fig. 1, the holes A are drilled about 10 ft. long to meet on the centre line. These are the "cut" holes and are fired first, thus throwing out a wedge of rock. The "easers," B (we are only dealing with the face just now) are then fired, throwing rock into the hole left by the cut-holes. The trimmers, C, cast the ring of material it is their duty to remove into the hole left by A and B, and finally the "lifters," D, lift their portion and also the loose material from firing C. This is very valuable work, for it casts the pile of muck away from the new face and leaves room for the drillers to rig their columns. The bench holes are fired in the order indicated.

Fig. 4
One of the Rugged Peaks

In preliminary work or when engaged in a new type of work it is wise to fire bench, cut and easers, and then come back to see what has resulted. It may happen that the new rock is so strong that only half the depth of the cut-holes has been blasted. It is then necessary to blast the remainder of the cut, because the trimmers will not break off rock all along their length unless the cut has made a sufficiently deep hole. It is easy to charge trimmers and lifters after the cut has been fired, because cut and easers throw the rock away from the face into the tunnel and thus it does not bury the lifters.

The object of so large a number of trimmers is to obtain a good shape—a very essential (Continued on page 349)

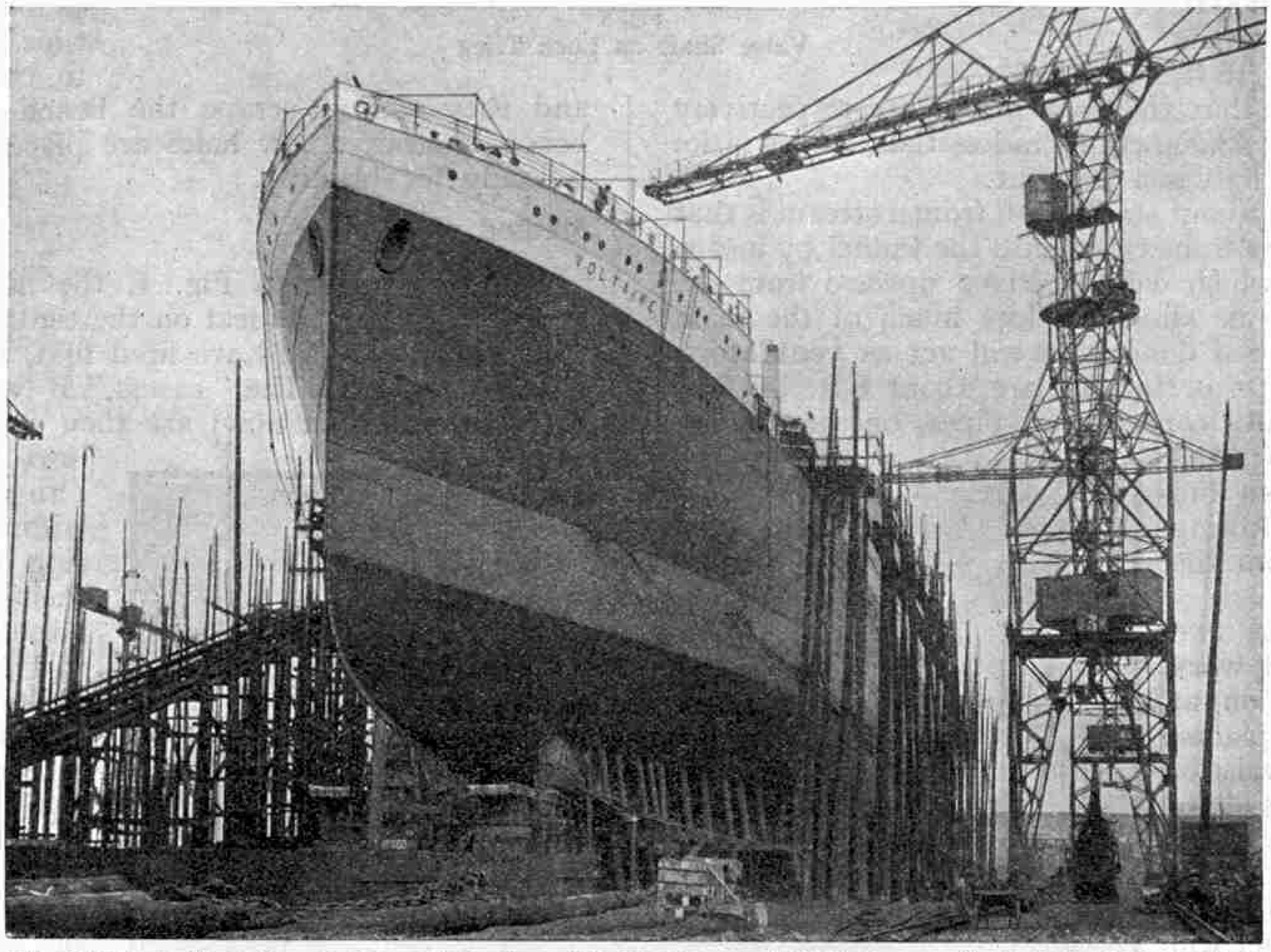
Planning and Building a Ship

By Captain John R. Mackay, Chief Engineer, "*Belgenland*"

IN all progressive shipping companies the question of new ships to replace those that are becoming obsolete, or to meet the anticipated demands of changing conditions, is always under consideration, either actively or passively.

Plans and specifications for the new ships, prepared by the technical department of the line, are the result of the experience and judgment of the management in consultation with their officials, ashore and afloat, who operate the ships.

All responsible officials are expected to make careful notes of any suggestions for improvements in the vessels in service and of criticisms, and to submit these to the superintendents of the various departments ashore for consideration by the management. I may say here that the motto of some of the big department stores also applies in shipping circles: "If you like our service tell your friends—if you don't like it, tell us!"



The "*Voltaire*" on the stocks ready for launching in the yard of Workman, Clark & Co. Ltd., Belfast

(This illustration is from a new book "From Slip to Sea," which we shall review in an early issue)

Perhaps some of the factors that are considered in the ship's design will be of interest. For instance, there is the question of deciding the amount of space to be devoted to passengers, and how much of that space for each class, first, second or third. Then there is also the question of the freight space, which question is governed by the type and amount of cargo to be carried, whether light, heavy or mixed.

Space has also to be allotted for refrigerated cargo, and room and location arranged for the provision stores, galleys and pantries. The speed required governs the space to be devoted to propelling equipment, and the length of voyage determines the bunker or fuel oil tank capacity. Space also has to be arranged for a sufficient amount of water ballast to keep the ship sea-worthy without cargo, if necessary. These are a few of the considerations that are merely tentative in the early designs.

The distribution of the weights is a very important factor, as it affects the stability of the ship—stability that governs the behaviour of a ship in a seaway, in different conditions of loading. It is the primary consideration of the naval architects, and is the subject of long and intricate calculations, and of judgment based upon experience with other vessels. In large vessels such as my ship, the "*Belgenland*," experiments are made with models in a large tank to determine the best proportions of form to meet the requirements.

When all is settled it turns out that the whole detailed arrangements of the ship are a compromise—the closest approximation we can make between the attainable and the desirable.

In this connection I might tell of an experience with a ship of about 8,000 tons, that the Red Star Line took over from one of the associated lines.

We took out the old passenger accommodation and fitted her up as a third-class ship, and I may say that she had the finest third-class accommodation of any ship afloat at that time, with fine public rooms, that were an innovation. I was appointed Chief Engineer of the ship and was sent to the shipyard as the company's inspector while the conversion was under way.

When the ship came to Antwerp, the manager came on board to inspect her with one of the superintendents,

who was a very big man. The superintendent commented:

"The alleyways are very narrow, Chief."

I replied: "That's true, Captain; but we could not have put the number of passengers' rooms in if we had made them broader."

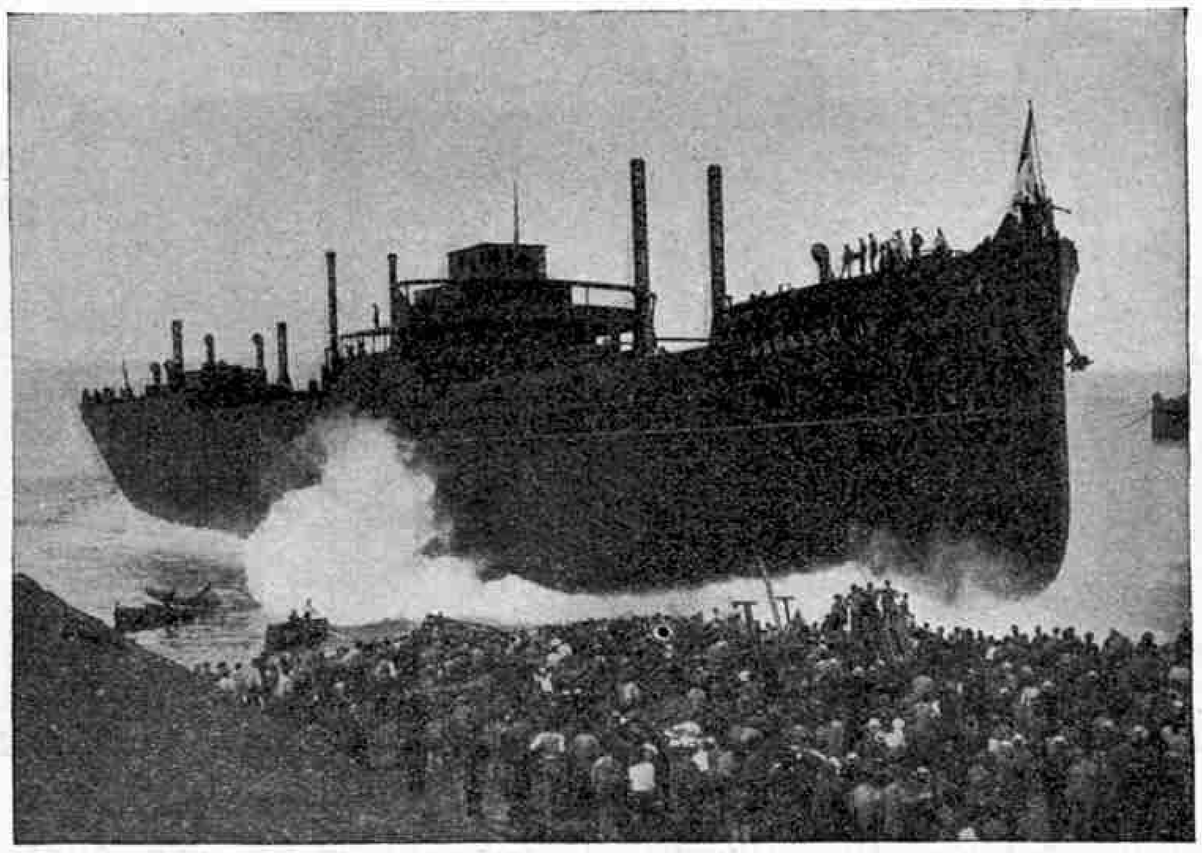
The manager, who was more accustomed to speaking French than English, said: "Just so, chief, you cannot cut five hams from one *porc*!"

So, when people tell me of something in another ship that we lack in the one I am in, if I know the other ship and her relative size, I also know that in many cases the other ship lacks something that we have, as "You cannot cut five hams from one *porc*!"

This consideration also applies to ornamental details. As in the case of any other business appliance, a ship is a commercial proposition, and only a certain amount of money can be laid out upon her. In the minds of our management, and in those of all shipowners of long experience, the most important factor in a ship's design is safety; the next is comfort; and then comes finish, elegance, or luxury.

Given the first factor, the second and third can be increased and improved as experience dictates and competition demands. The "*Belgenland*" was called the "Luxury Liner of 1923," but you may rest assured that the other factors were not sacrificed in earning that title.

After the plans have been passed and all details settled the construction of the hull and machinery is commenced. Shortly after this work has been put in hand, the Chief Engineer is sent to the shipyard as inspector for the owners, unless they have a permanent inspector at the shipyard. All tests of apparatus are carried out in his presence, and the workmanship must be to his satisfaction. It is his duty to notify the manager of the line, through his superintendent, of any cause for dissatisfaction, and to suggest any improvement on the original specification or designs that may occur to him. He makes a weekly report of progress to the manager.



Our illustration, which shows a launch at an Italian shipyard, is from an interesting book "From Slip to Sea" by A. C. Hardy. This book will be reviewed in an early issue of the "M.M." but meantime those readers who wish to learn something more of the planning and building of a ship will do well to read the book mentioned

As the work progresses other officials who will form part of the staff of the ship will come to the yard to assist in the work of inspection, and become conversant with the details of the hull and machinery equipment.

At certain stages of the work the manager of the line and his superintendents visit the ship, note progress, and suggest any alterations that they consider advisable. These visits become more frequent as time goes on, and there is greater scope for an increasing number of workmen on the job. When the "*Belgenland*" was nearing completion, for instance, there were night and day shifts of men, approximating 12,000 at work on, or for, this ship.

It takes from two to three years to build such a ship, but the time comes at last when the critical moment of launching the hull is over. It is then towed to a big crane where the engines, boilers, and heavy weights are placed on board. Stability tests are made, and a dock trial of the engines carried out. Then the ship is dry-docked and a final examination of the underwater hull, propellers, rudder, etc., carried out, while the finishing coats of paint are put on.

Then follows the official trial trip, on which tests are carried out for power, speed, and steering qualities. If these are successful, the vessel is handed over to the owners and their staff takes over the ship.

The last few months occupied in finishing the vessel are strenuous ones, for the shipyard heads, and for the owners' representatives at the yard. To any man with imagination it is rather a thrilling moment when the trial trip being over, the ship is stopped, and most of the shipyard men leave, to be replaced by the vessel's staff on the bridge and in the engine-room. In a few minutes the ship is again under way—this time as a new unit for the company's fleet.

This short account of the early days of a ship was broadcast by Captain Mackay on board the "Belgenland" when in the Bay of Bengal last year. It was subsequently printed in the "Ocean Ferry" and is reprinted here by special permission of the Editor of that Magazine.

A further article, in continuation of the broadcast talk, will be printed in an early issue of the "M.M."—EDITOR.

Motor Car Differential Gear—

(*Continued from page* 336)

road surface, for no braking effect has been applied to the rear axle itself.

The gear wheel secured to the shaft of this road wheel will turn in the direction in which the car is moving, and this sets in motion the pinions 5 and 6, because the latter must rotate about their own axles since they cannot revolve round the gear wheel (it will be remembered that the frame 7 is locked in position by the brake). The pinions, in turn, rotate the gear wheel secured to the shaft of the slipping road wheel, but it will be found by following the direction of rotation of the various wheels that this gear wheel revolves in the opposite direction to that in which the car moves.

It should be noted that if both the driving wheels grip the road equally, the resistance on the shafts 1 and 2 is also equal and there is no reason why the pinions should commence to turn. Both wheels will therefore remain immovable and the car will be brought quickly to a standstill.

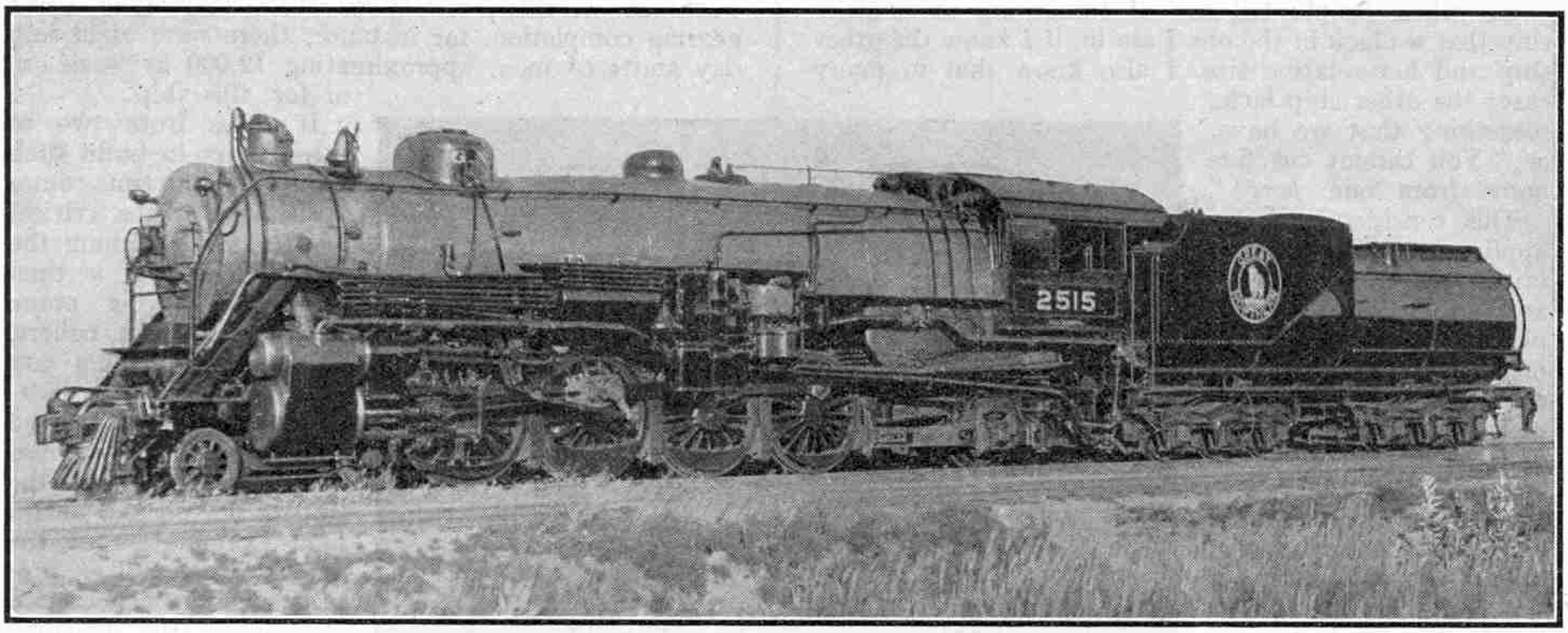
Deleting the Differential

In view of these defects in the operation of the differential, the designers of certain light cars decided to leave it out altogether, and to fit a simple non-variable bevel drive between the propeller shaft and the back axle. When a car built in this way describes a curve or takes a corner one of the back tyres must slip on the road to allow for the differences in speed between the two wheels, and some surprise was caused in motoring circles when it was discovered that the cost of tyre renewals in such cars was not greater than in the more conventional differential-fitted vehicles.

Many patent devices have been produced within the last few years in connection with the differential, but none appear to show any really important improvement or advancement upon existing types. A fortune still awaits the man who invents a form of balance gear that will transmit the power of the engine to the driving wheels in an efficient manner, without the disadvantages mentioned above.

Coaling at 67 Tons a Minute!

Some Interesting American Railway Figures



G.N. (U.S.A.) Engine No. 2515—a Mountain Passenger Engine, Class P2

SOME interesting comparisons between the railways in this country and those in the United States, were made in a lecture, delivered a short time ago, by Mr. R. Bell, Assistant General Manager of the L.N.E.R.

The area of the United States, Mr. Bell pointed out, is 35 times that of Great Britain, and the volume of the U.S.A. rail-borne freight is expanding at a very rapid rate.

The locomotives used are vastly larger than anything seen on this side of the Atlantic. Quite recently, for instance, the Union Pacific Railroad put into traffic a three-cylinder locomotive with twelve coupled wheels! This engine has a tractive power equal to $2\frac{1}{2}$ times that of the L.N.E.R. eight-coupled class: its full wheel formation is 4–12–2.

The performances of the U.S.A. big engines are quite in keeping with their size, *e.g.*, 162 miles non-stop run in less than 6 hours with 2,455 tons of freight train behind, and 182 miles in 7 hours 50 minutes with 3,797 tons.

The engines also go on very lengthy trips. Mr. Bell quoted the case of a G.N. (U.S.A.) coal-burning locomotive that ran a distance of 1,898 miles on a single trip, thereby creating a record. The time the engine was away from its shed amounted to 109 hours 30 minutes.

Some useful facts were given regarding the coaling of the American locomotives, and in this respect, at any rate, our home railways seem to score, even taking into account the fact that American tons are 10 per cent. less than English tons.

Whilst in this country about 125 lb. of coal will haul 1,000 tons of freight and wagons one mile, it requires 159 lb. to do the same work in the U.S.A. Inferior coal, steeper gradients and adverse weather conditions were advanced as the possible explanation.

Where the automatic stoker has been adopted on the U.S.A. railways there has been a saving of over 25 per cent. in fuel consumption.

It is perhaps in the matter of coal shipments that the American figures are most amazing. There is a record that a steamer served by four conveyors at Sewall's Point took on board 11,875 tons in $2\frac{3}{4}$ hours—a rate of 67 tons a minute! In this country, shipment (with one conveyor) at a rate of 700 tons an hour would be regarded as very quick despatch indeed. Coal trimming in the States is often done by means of mechanical appliances.

Mr. Bell gave some figures relating to the average train-load in the U.S.A., which, he stated, came out at 771 tons, compared with our 133 tons.

In matters of electrification, the practice in the U.S.A. is to use electric locomotives on a larger scale than we do. On the Philadelphia to Wilmington line, for instance, a distance of 28 miles, they propose to use electric locomotives that are able to take 16 Pullman cars along at 75 miles per hour. The same locomotives can handle 100 of the big U.S.A. freight cars (the average car load in the U.S.A. is 26.8 tons) at 35 miles per hour.

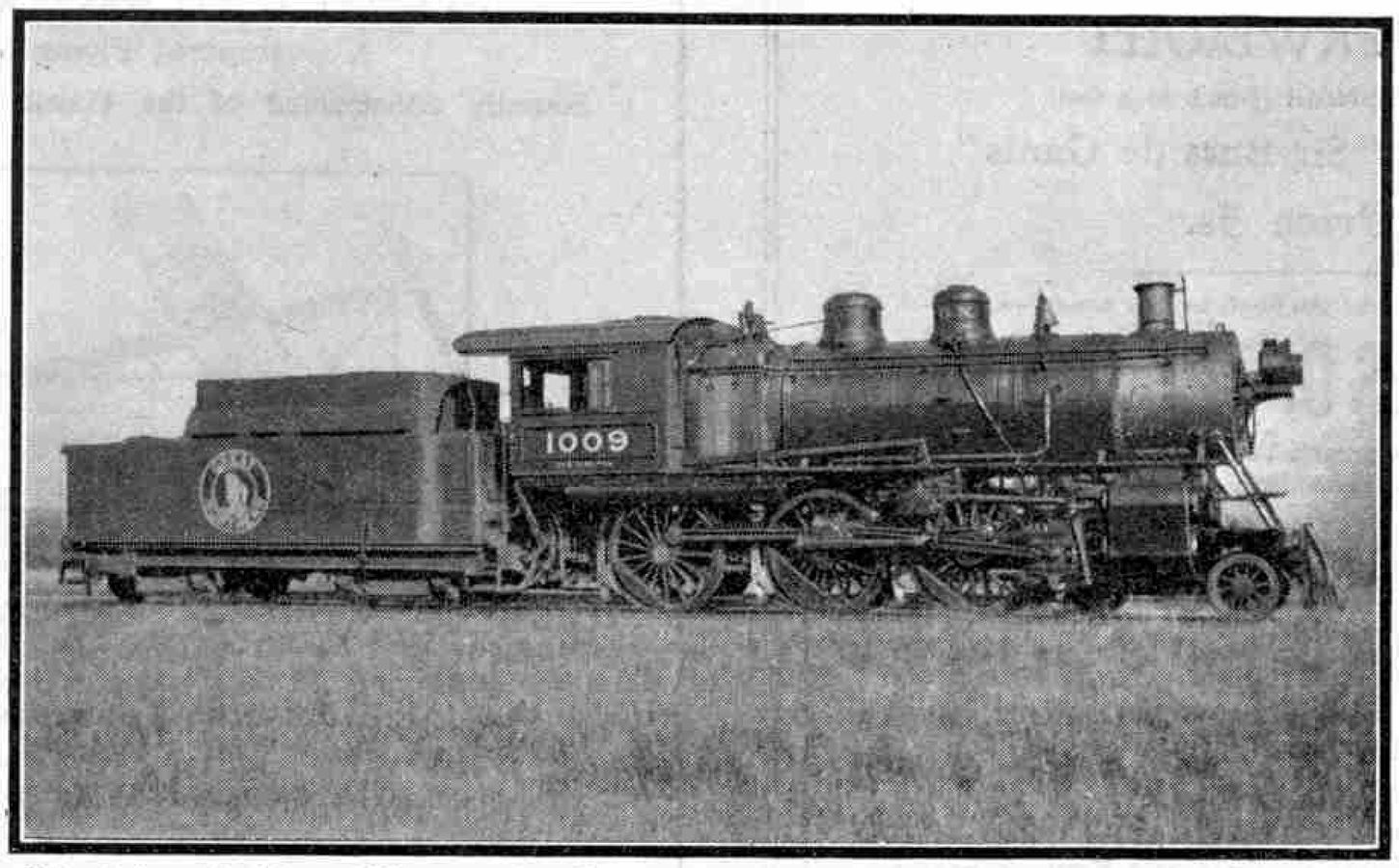
The use of automatic signalling is also being developed, and a main line from St. Paul to Seattle, a distance of 1,794 miles, has just been equipped. A third of the mileage is worked by colour light signals for use both by day and night. Automatic train control is also extending.

During the past summer the L.N.E.R. Company ran half-day excursions freely and more than a quarter of a million people were transported to seaside resorts at low fares. In America, however, they claim to have had this year the greatest one-day excursion movement ever arranged, 300,000 people having been conveyed in one day from Chicago to a place 40 miles away!

In the course of his lecture, Mr. Bell gave many facts and figures in connection with railway affairs that must have been new to his audience. He mentioned,

for instance, that in the making of a new line £1,500 worth of capital had to be found for every railwayman employed, whereas about one-seventh of that amount invested in a modern colliery would be sufficient to start one miner. He stated also, that one of the busiest pieces of track in the world was that between Liverpool Street and Bethnal Green Junction, where sometimes as many as 24 trains pass over the same piece of line within the hour. He concluded his remarks with a very fine tribute to the pioneer work done by the old North Eastern Railway in the matter of electrification, the adoption of high capacity wagons, and the introduction of statistics and of arrangements for the education of the staff.

* * *



This photograph, taken at Vancouver last September by K. Merilees, an "M.M." reader, shows engine No. 1009 of the Great Northern, U.S.A.

The engine illustrated on this page is No. 1009 class E.14.S of the G.N. (U.S.A.) Railway. The letter "S" after the class number indicates superheater. The engine was built at the Baldwin Locomotive Works in 1909.

The driving wheels are 73 in. diameter, the cylinders 23½ in. × 30 in., piston valves and Walschaerts' Valve Gear are fitted. The steam pressure is 200 lbs. and the total weight of the engine is 200,000 lbs. The weight on the drivers is 150,000 lbs. and the total weight of the engine and tender is 348,200 lbs. The length of the engine and tender is 70 ft. 0¼ in. The engine is employed on passenger service on branch lines.

The engine illustrated on the previous page is a fine example of an American locomotive. It has 73 in. driving wheels, which carry a weight of 242,000 lbs. The cylinders are 29 in. × 28 in. and the engine is equipped with a booster on the trailing wheels. Feed-water pump and heater are fitted on the left side, and compressed air operates a reverse on the valve gear.

A similar loco to the one illustrated (which is a photograph taken by F. Merilees, an "*M.M.*" reader in Vancouver, B.C.), established a long-distance endurance record that is said to be unique in the history of railroading. This G.N. passenger engine No. 2517 is one of the big and fast giants that haul the famous "Oriental Limited" train regularly, and it brought much glory upon itself when it completed a round trip run of 3,600 miles between Seattle and St. Paul.

On its second trip, which was unbroken excepting to take on fuel and water and for several hours' inspection in St. Paul, this engine took east an express train of 18 cars and brought back the Great Northern fast mail, known in the United States as the fastest trans-continental train in America. No. 2517 therefore made wonderful speed, and showed that it possessed also a remarkable endurance. Twelve engineers and as many firemen in each direction—a total of 48 men—handled this engine on its record trip.

This engine, which is one of 28 recently purchased by the Great Northern to haul its "Oriental Limited," "Glacier Park Limited" and fast mail trains across the continent, is 95 ft. in length over all and weighs 617,000 pounds.

Competition Results—(*continued from page 367*)

was the judge upon whom fell the task of discriminating between the correct solutions. Eventually the following awards were made:—1. A. G. CLAYPOOLE (Kettering); 2. D. W. A. MINETTE (Leicester); 3. E. THRELFALL (Southport).

For the guidance of those who made mistakes or were unable to trace any of the phrases and words upon which the contest was based, we append the correct solution:—Rhodesia, Argentine, Belgium, Bolivia, Danzig, France, Costa Rica, Greece, Italy, Marienwerder, Mozambique Co., Switzerland, United States of America, Salvador, Venezuela, Newfoundland, Canada, Liberia, Bermuda, Liberia.

Overseas Results
19th Drawing Contest

The subject of this contest was "A Steam Roller," and many very excellent entries were submitted.

The awards were as follows:—

First Prizes: Section A, J. V. ROSS (Durban); Section B, T. JAMES (Malta). Second Prizes: Section A, E. THOMAS (Sidney); Section B, F. WILLIAMS (Johannesburg). Consolation Prizes: V. R. HEERAMANECK (New Gandevi, Bombay); I. MINOCHER (Bombay).

Doublets No. 2

1. B. K. CHOKSI (Karachi); 2. G. D. L. PERIS (Ceylon); 3. J. A. GOMES (Bombay). Consolation Prizes: E. HOLDER (Port-of-Spain); C. MAL (Delhi).

A Visit to a Machine Shop—

(*Continued from page 299*)

however, is a crankshaft of extraordinary, almost weird, shape and proportions. In this the crankpins were set an angle of about 30 degrees to the line of the main bearings, and the piece from which the shaft was machined was all one forging. To machine such crankpins with ease and accuracy, and yet without undue cost, was only made possible by employing the special "crank-pinning" machine, which is part of the varied equipment of these shops. This is able to take a cut down a web of 14 in.

The feature of this machine is that the tool revolves while the work is stationary. The completed job is made truly circular to within extremely fine limits. The machine can take a cut over 6 in. wide with a feed of .05 of an inch.

The crankshaft in question measured 17 ft. in length, with three 9¼ in. bearings, and is a remarkable example of what can be done in these shops. The total weight of this crankshaft, which we illustrate herewith was 2 tons 16 cwt.

Conquest of the Air—(*continued from page 291*)

in the departure of their design from that of the conventional aeroplane, undoubtedly were regarded with a certain amount of bewilderment. Later in the afternoon they were alone in the air and the strangeness of their respective movements caused great amusement—in fact many people apparently regarded them, not as serious aeroplanes, but as practical jokes!

The "*Pterodactyl*" certainly earned the right to be called "The Clown of the Air," for many of its movements were curiously reminiscent of the antics of a clown in the circus ring. Indeed, the man who described it as "a huge moth making a noise like a mowing machine" was not far wrong! Serious observers realised, however, that the apparent clumsiness of the "*Pterodactyl's*" movements were really a demonstration of the machine's remarkable safety.

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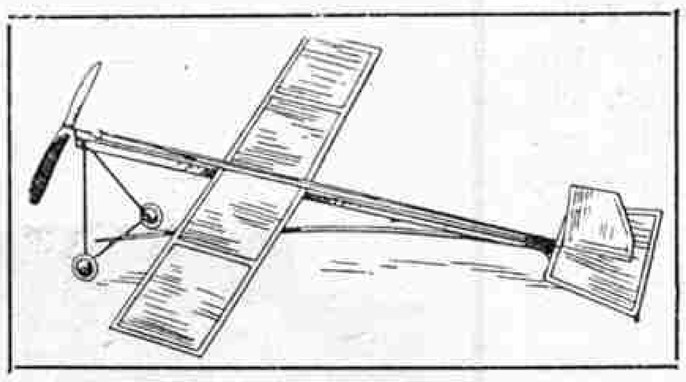

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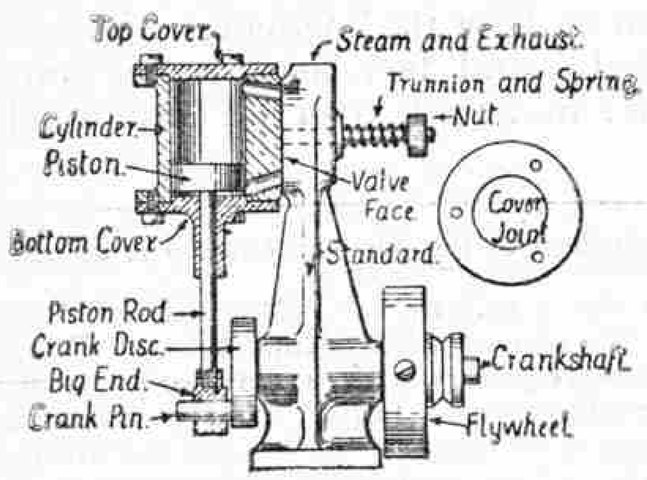

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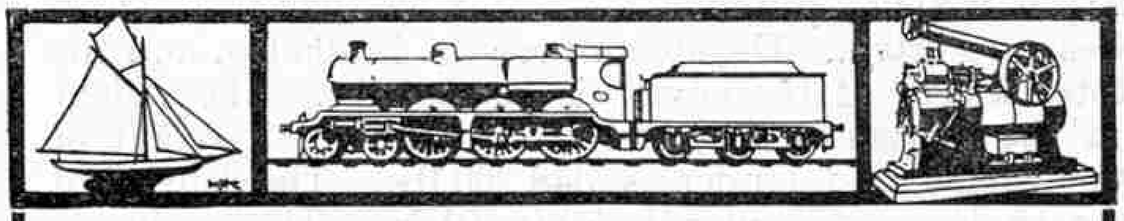

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HOW SHIPS "TALK" TO EACH OTHER

By MANNIN CRANE

(Reprinted by permission from the "Cunard Magazine")

EVEN as ships have souls of their own, so too, has their voice an individual note. The purweet of the destroyer's syren makes a strong contrast with the deep, almost sheep-like, baa-baa of the modern ferry boat. Who has not heard the humorous ssssh-eeek-garhh of the antiquated tramp steamer for all the world like a stammering schoolboy at that period when his voice breaks alternately between treble and bass?

There is something comforting and solid in the not unmusical but powerful treble note of the liners. Pilots, tugboatmen, and other workers of our large estuaries almost know each individual ship. They certainly know the different types of ships. Very little imagination is required by these men lying snugly in their beds at night to picture the happenings in the river traffic, although they may be a mile or more from the river.

For example, a liner is due in the early morning. The "*Cunardia*," having passed the Rock, is somewhat impatient for the tugs, but a long blast brings them to heel like terriers. Her deep booming note is well known, being shared only by two other sisters, who are at that moment well over the ocean.

It is foggy on the river, which is indicated by bells being rung at intervals by vessels at anchor. The ferry boats, too, are more vociferous than usual.

Not only that, but steamers of all sorts and sizes talk to each other much more frequently, and, be it noted, with impatience.

Hark for a moment to that coaster. She has given two short toots on her whistle, for she has noted a big tramp steamer coming down towards her. The two short blasts is the steamer's way of saying, "Pardon me, but as there appears to be a chance that we may bump into each other I propose to turn towards my left hand side. Perhaps you will be good enough to indicate your movements in the immediate future."

The big tramp, however, does not appear to be unduly worried about the situation. The coaster does not share this view. She shrieks out, "Are you deaf? It's you I'm talking to. *I'm* going to my left hand. What are *you* going to do?"

This, translated into "toot" language, would be rendered thus. One long blast to draw attention, followed by two short blasts, "I am directing my course to port."

As an earnest of his intention the coaster turns in the indicated direction. The big tramp, cumbersome, ungainly, and sluggish, has been much concerned about a small sailing vessel, a quarter of a mile further on, and she has been pondering chances all round. Will the sailing vessel turn on the other tack or not? Is it possible to go between the coaster and the sailing craft, or would it be best to go outside both, in which case the tramp might be getting on the wrong side, for all vessels must keep to the right hand side in channels.

The coaster is not so slow as her size and rig might indicate, and suddenly the tramp steamer realizes that she must do something and do it quickly.

She blows two blasts, and in answer the coaster's double blast almost seems like "Thank God!"

Suddenly, then, the tramp steamer finds that she is not so nimble on her heel as might be, and she lets fly with three short blasts, which, being freely interpreted, means, "This looks like being a tight corner. I'm taking no chances. I'm going full speed astern." This latter sentence, however, should not be taken literally, what it really means is "My engines are going astern"—not necessarily the ship, as the vessel may still be forging ahead.

Which is easier said than done, for it is not easy to stop a deadweight mass of ten thousand tons. The little coaster does not have much faith in the big tramp's ability to pull up, but this sort of thing happens many times in the course of a month. Nevertheless, she sounds three short blasts and goes astern, for the channel hereabouts is not too wide. A crack and speedy cross channel steamer calmly nips between the two, having heard the conversation, and in a matter of seconds is abreast the sailing vessel where preparations are being made hurriedly in case she may have to forego her right of way as a sailing vessel should the tramp and the coaster find themselves in difficulties.

Rules and regulations have been drawn up from time to time with the object of preventing collisions at sea. These rules are adhered to internationally, and a large part of them is concerned with signalling their intentions by means of sound, such as syrens, whistles, bells.

Warning signals also play a large part in preventing collisions. For example, a vessel must, in fog, by means of signals, indicate whether she is at anchor or not, whether she is moving through the water, or even when towing another vessel there is a special signal.

There are also a number of other signals usually based upon the Morse alphabet; a common example is that of the letter "U," which, in Morse, is two shorts followed by a long blast, the meaning of which is "You are running into danger." A case is on record recently whereby a ship was saved from disaster by this simple signal made on another steamer's whistle.

Ships can express themselves joyfully too, as all who have heard the welcome given to the New Year, can testify.

The Meccano Guild

A Great Fellowship of Boys

President: Mr. Frank Hornby ——Inventor of Meccano

What the Guild Means

The Meccano Guild is an organisation for boys, started at the request of boys, and conducted as far as possible by boys. In joining the Guild a Meccano boy becomes a member of a great brotherhood of world-wide extent, every member of which has promised to observe its three great objects ; wherever he happens to be—even in strange countries—he will know he has met a friend whenever he sees the little triangular badge. The Meccano Guild is bringing together Meccano boys all over the world, and is helping them to get the very best out of life.

How it Commenced

More than a million boys in Great Britain derive their greatest indoor pleasure from Meccano. Before the Guild was formed, hundreds of these Meccano boys wrote to us every week. They told us how they wished they could be put into communication with other Meccano boys and how they longed to be able to meet them. They asked if arrangements could be made so that their wishes might become an accomplished fact. We responded to their repeated and increasingly numerous appeals, and as a result the Meccano Guild came into being.

Why You Should Join

Every Meccano boy should be a member of the Meccano Guild. All who have studied its objects must agree that the Guild cannot fail to have a profound effect for good on the lives of its members. It is ready to be of service to each individual member—to help or give advice whenever requested. At the head—guiding and controlling, and taking a personal interest in this great movement—is the President, Mr. Frank Hornby, Inventor of Meccano and Managing Director of Meccano Limited.

The Headquarters of the Meccano Guild are at the Head Offices of Meccano Ltd., Binns Road, Liverpool

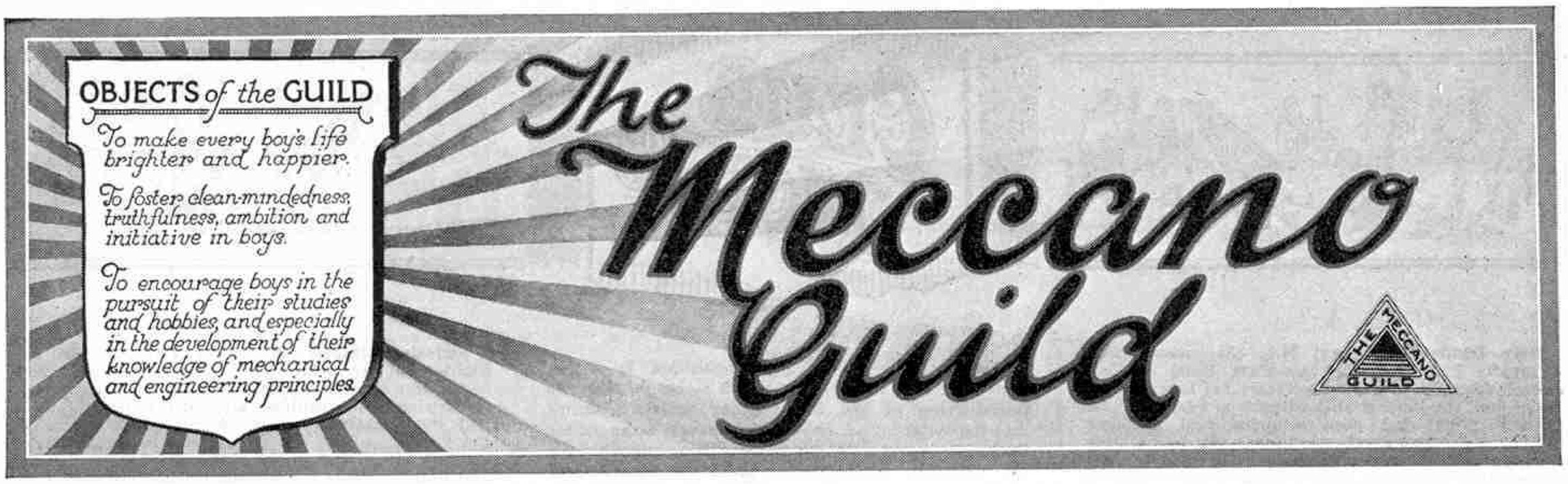
The Three Great Objects of the Guild

1) To make every boy's life brighter and happier.
(2) To foster clean-mindedness, truthfulness, ambition, and initiative in boys.
(3) To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.

Membership of the Guild is open to every boy possessing a Meccano Outfit, or Hornby Train Set, who satisfactorily fills in the prescribed application form. The only conditions are that members promise to observe the objects of the Guild and to wear their badges on all possible occasions.

BADGE OF MEMBERSHIP

The above is a reduced illustration of the New Meccano Guild map, a copy of which will be sent to any reader on receipt of an addressed envelope bearing a halfpenny stamp.



With the Secretary

Visiting Committees

An interesting scheme has been adopted by the Falmouth Wesley Meccano Club. This takes the form of a special committee of three members appointed to visit any members of the club who are prevented by illness from attending meetings. This idea appears to be an excellent one and full of possibilities. An enthusiastic club member who is confined to the house, or perhaps to his bed, is certain to appreciate a short visit from three of his fellow members bringing the latest news of the various club activities. Naturally such visits could not be paid to members suffering from infectious complaints, but apart from such cases nothing but good should result from a scheme of visits.

A further development of this idea would be to institute a series of visits to members who have not attended meetings for some time and who appear to have lost interest in the club. I know personally of several cases where a timely visit has brought back "into the fold" a member who was on the point of cutting himself off entirely from his club. Circumstances are always liable to arise that either make it impossible for a member to attend meetings or distract his interest in some other direction so that the club is temporarily forgotten. After a while the abnormal conditions pass away and the member once more begins to think about the pleasant times he has had among his club mates, but in many cases he feels that he has been away from them so long and lost touch with them to such an extent that it is no use beginning again. In a case of this kind a visit from an enthusiastic and tactful committee is almost certain to bridge the gulf and restore the member to happy club surroundings.

Club Outing Funds

During the summer months the majority of Meccano Clubs organise visits to places in which their members are interested, such as gas or electricity works, engineering shops, docks and harbours, factories of various kinds, etc. The number of such visits is generally strictly limited by financial considerations. Obviously the expense of these outings cannot be defrayed out of club funds, for although the cost per individual member is usually quite small, the total amount in the case of a fairly large club is very considerable. On the other hand, individual members often find that, when the time arrives to make some pre-arranged visit, they cannot go because they are unable to pay their share of the expenses.

In order to overcome this difficulty several clubs have adopted the very excellent plan of opening a savings bank for the purpose of accumulating funds for visits. Each member pays in weekly a small sum, no definite amount being fixed, and this money, gradually increasing, soon becomes sufficient to meet the expenses of the visits decided upon. When the time for a particular visit arrives, each member is able, if he so wishes, to draw from the bank sufficient money to pay his share of the cost of the outing; or alternatively, if he has sufficient money in hand he may leave his bank money untouched for future use. I recommend all Leaders to consider seriously the adoption of a savings bank scheme of this kind with the object of increasing the scope of club activities. It should be borne in mind, however, that such a scheme, to be really successful, must be commenced early in the year in order that sufficient sums may accumulate.

The savings bank may be used of course to accumulate funds for other purposes. The Holy Trinity (Barnsbury, London, N.1) Meccano Club, for instance, has two separate bank schemes. Deposits in the first are for the purpose of purchasing Meccano and Hornby Train goods, materials for fretwork and similar hobbies, and for any special purposes for which the sanction of the Leader has been obtained. Any money withdrawn is to be used only for the purpose for which it was deposited and either a receipt or the goods purchased must be shown to the Leader as proof of this. The second is purely a club outing fund and the money deposited is to be used only for fares, refreshments, etc., on outings or visits arranged by the club. Any withdrawals from this fund must be notified at least a week before the outing takes place.

Club Camps

I am interested to note that even at this early period of the year various club Leaders are already considering the preliminaries for holding a club camp during the summer. As I have stated on previous occasions, I am strongly in favour of club camps because, given reasonably good weather, a camping holiday is ideal from every point of view, including the very important one of cheapness. Apart from fine weather, the one really essential thing for a successful camp is good organisation, and this can only be secured by careful preparation long in advance.

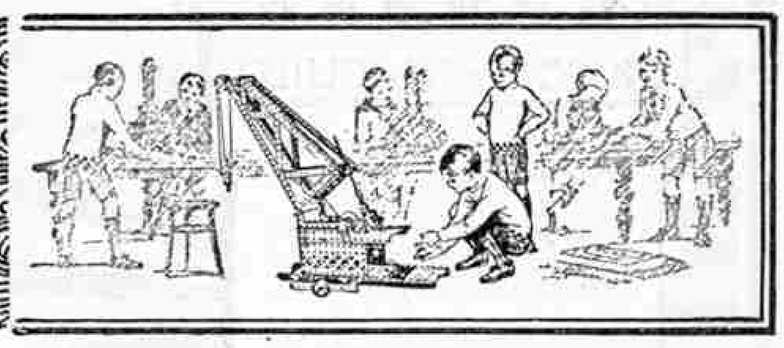
The camping period will vary of course with different clubs, and it can only be settled after the Leader has definitely ascertained when he will be free to take charge. In regard to the site for the camp, a great deal of assistance may be obtained from the special camping publications issued by at least two of the railway companies. These booklets probably will be available this month and enquiries should be made for them in good time. They provide extremely useful information regarding sites for camps of all sizes in the beauty spots of the country, with full particulars in each case.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places, and boys interested in becoming members should communicate with the promoters, whose names and addresses are given:

LONDON—W. D. Berry, 116a, Queens Road, Battersea, London, S.W.8.
HARROW—Arthur D. Joyce, The Manor House Lodge, Bonnersfield Lane, Harrow.
HYTHE—A. B. E. Bisham, "Oak Cottage," 16, Stade Street, Hythe, Kent.
KETTERING—Alan E. Tavener, 39, Broadway, Kettering.
CHICKERELL—S.G.Hayne,3,New Building, Putton Lane, Chickerell, Dorset.
SCARBOROUGH—Harry Wanless, 2, Murray Street, Scarborough.
HAMPTON—J.Croxford,The Chalfonts,Nightingale Road,Hampton, Middlesex.
WOODVILLE—L. C. Adey, 239, Occupation Road, Woodville, Nr. Burton-on-Trent.
HINDLEY GREEN—Cyril G. Scarborough, 6, Scowcroft Street, Hindley Green.
NEWARK—Clive Wilkinson, 17, Spring Gardens, Newark, Notts.
BRISTOL—J. R. Pearce, The Dairy, Westbury-on-Trym, Bristol.
HULL—C. H. Wilkinson, 22, Cromer Street, Beverley Road, Hull.
HANLEY—Frank Sharpley, 102, Lichfield Street, Hanley, Stoke-on-Trent.
REIGATE—Miss E. Jordan, 7, South Road, Reigate, Surrey.
SOUTHAMPTON—W. G. Bishop, 106, St. Deny's Road, Southampton.

CLUB NOTES



Holy Trinity (Barnsbury) M.C.—The membership is rapidly increasing, new members being enrolled at each meeting. The new secretary has taken up his duties but the club is still without a President. A Parents' Night has been arranged and promises to be very successful. A recent Model-building Evening proved very popular and the models were so good that the judges had a very hard task in awarding the prizes. The Leader, secretary and several members paid a visit to the British Industries Fair and, as may be imagined, were not long before they fell victims to the attractions of the Meccano Stand! The Annual Concert has been arranged for April 30th. Club roll: 46. *Secretary*: F. W. Johnson, 23, Market Street, Edgware Road, Paddington, London, W.2.

Withington Kim M.C.—A recent Party proved very successful. After tea, games of various kinds were played with great enthusiasm and a competition was organised. The proceedings terminated with the distribution of surprise snowballs and balloons. Lectures continue to be a popular feature of the syllabus. Club roll: 10. *Secretary*: Cyril Bell, 40, Davenport Avenue, Withington, Manchester.

Teignmouth Congregational M.C.—A recent Meccano evening passed off thoroughly well, and the winning models were a Canoe in coloured Meccano, a Signal and a Roundabout. Draughts are popular and tournaments are frequently arranged. Members hope to perform the Meccano play "*Nonsense Nana*" at their forthcoming Exhibition. Club roll: 39. *Secretary*: Donald Ford, 16, Higher Brook Street, Teignmouth.

Winchmore Hill Collegiate Schools M.C.—Members have been very busy making various articles in Fretwork for an Exhibition held recently. A prize was given by the Leader for the best model and this was won by Irvine. A Miniature Railway ran very well during the evening. Club roll: 43. *Secretary*: K. Walden, 18, Old Park Road, Palmers Green, London.

Ilfracombe M.C.—A very interesting Lecture on "Lighthouses" was enjoyed by all. A recent exhibition was marred by bad weather, but nevertheless was successful, a fine Hornby Layout being a great attraction. Six Hornby engines were running. Club roll: 25. *Secretary*: R. Trawin, 33, Victoria Road, Ilfracombe.

Withington M.C.—Two good Lectures were recently delivered by Mr. E. Saunsbury and the secretary, their respective subjects being "Why An Engine Has a Valve Gear" and "Stephenson's Link Motion." Both lectures were illustrated by drawings. The club has held several Stamp Collecting Evenings, which will probably become a regular feature of the syllabus. Model-building evenings and Contractors' Nights are held regularly, and it is proposed to hold a Lantern Lecture on "The Manufacture of Steel." Club roll: 10. *Secretary*: K. Cradduck, 36, Mauldeth Road West, Withington, Manchester.

Weston M.C.—Has a new acquisition in a fine Lantern loaned by a patron, which makes possible the introduction of the ever-popular lantern lectures into the syllabus. A fine Exhibition was arranged for December, some excellent models being prepared for the occasion. A Workshop model was loaned from Headquarters. *Secretary*: Ralph B. Nichols, 3a, Royal Parade, Weston-super-Mare.

Middlesbrough Meccano Club

Our group shows some of the members of Middlesbrough Meccano Club with Mr. Allick, the Leader, in the centre. This club was formed in 1925, affiliation was granted in February, 1926, and since then excellent progress has been made. Last year the club held an exhibition on an enterprising scale and this was attended by some 250 people. The club has its own magazine, which is an excellent production.

Stockton-on-Tees M.C.—An Exhibition was recently held and several hundred people visited it, including the members of Middlesbrough Meccano Club. Two Working Models were loaned from Headquarters for this occasion. Club roll: 56. *Secretary*: N. Middleton, 14, Victoria Avenue, Norton Road, Stockton-on-Tees.

Brighton (Dublin) M.C.—A good membership is maintained and successful meetings are reported. A visit was paid to the Match Factory of Maguire and Paterson Ltd., and was greatly enjoyed. A Cross-Word competition is to be held shortly. Club roll: 13. *Secretary*: W. E. Malone, 3, Pretoria Terrace, Harolds Cross Road, Dublin, Ireland.

Diss M.C.—Owing to the resignation of Mrs. Maling, the popular Leader, this club has been handicapped for some time. The Rev. Law has now accepted the position, and under his guidance good progress is anticipated. It is hoped to secure the services of two local gentlemen as Hon. Presidents. Leader: Rev. Law, 16, Mount Pleasant, Diss.

Rhos-on-Sea M.C.—Rifle-shooting is a popular feature and a recent contest proved very successful. A Model-building Competition produced some excellent work, the three prizes being awarded respectively to a Meccanograph, a Torpedo Boat Destroyer and a Railway Yard Crane. A Lantern has been presented to the club by Mr. Turner and a night has been arranged upon which members will bring their own slides. Club roll: 17. *Secretary*: G. E. Mellor, "Bradda," Allanson Road, Rhos-on-Sea.

Victoria (Glasgow) M.C.—The Fifth Annual Exhibition has been held with a very fine show of models and a large Hornby layout. A Model Electric Railway constructed by members attracted much attention and was greatly admired. Many visitors attended the Exhibition and the members were congratulated on their splendid display. Games Nights are popular and Model-building is a popular feature of the syllabus. Ten-minute Papers given by members are greatly enjoyed. The club is at present handicapped by the lack of a Leader but excellent progress is being made under the guidance of the secretary. Club roll: 43. *Secretary*: W. P. Morrison, 4, George Street, Scotstoun, Glasgow.

Derby M.C.—The membership shows a steady increase. A popular feature is five-minute lectures by the members, and these are proving very interesting. A Hornby and Meccano evening was very much enjoyed and among the models exhibited were a Field Gun and a Distance Indicator. It is hoped to arrange a Social this session. Club roll: 37. *Secretary*: W. P. Smith, 435, Uttoxeter Road, Derby.

Oxton M.C.—Good progress is reported and meetings are well attended. A Meccano outfit is to be purchased for club use and at present the funds amount to £2. Lectures and Competitions are popular and the Library is steadily growing. Members are on the look-out for a President, and they hope to secure one very shortly. Club night is Saturday and the club-room is in Shrewsbury Road, Oxton. New members will be heartily welcomed, and should apply to the secretary, who will be pleased to give full particulars. Club roll: 14. *Secretary*: C. G. Jones, 39, Waterpark Road, Prenton, Birkenhead.

South Africa

Clifton (Johannesburg) M.C.—The Leader has been obliged to leave the district and a new Leader has been appointed. Table Tennis is a popular feature, and a fine set has been presented to the club. A visit was paid to the Malvern Wesleyan M.C. on the occasion of their Christmas party, which was a great success, despite the rainy weather. Club roll: 19. *Secretary*: Hermann Jacobsen, 169, Loveday Street, Clifton, Johannesburg, Transvaal, S. Africa.

Durban M.C.—An Exhibition was recently held for which Messrs. Cotts and Co., agents for "Shell" motor spirit, presented prizes of Meccano parts to the value of £125. Over 40,000 people visited the exhibition. A Carnival is to be held shortly. There will be an interesting competition open to all boys between 8 and 16 years of age who own Meccano sets. All the models are to be chosen by the Leader from the Manual of Instruction. At a given time the competitors in the various sections will set to work on the model selected, and a prize will be awarded to the first boy in each section who has his model completed or most nearly completed, and with the least mistakes. Leader: Mr. G. E. Patterson, 24, Hunt Road, Durban, S. Africa.

Clubs Not Yet Affiliated

Carharrack M.C.—Difficulty is being experienced in regard to securing a suitable club-room. Suggestions will be welcomed, and any boy interested should communicate with Mrs. G. Poulter, York House, Carharrack, Cornwall.

Upwey (Weymouth) M.C.—A Leader has not yet been secured, but fifteen boys have already joined the club and others will be made very welcome. *Secretary*: W. Ravenscroft, The Waterworks, Upwey, Weymouth, Dorset.

Parktown (Johannesburg) M.C.—A successful club has been formed and a Leader has been secured. Mrs. Reid has very kindly placed a room at the disposal of the members until more suitable accommodation is secured. Boys wishing to become members should write to the secretary, Jim Hering, 7, The Crescent, Jansmuts Avenue, Parktown, W., Johannesburg, S.A.

Merthyr Tydvil M.C.—A promising little club has been formed and a Leader and a club-room have been secured. Boys wishing to join should write to Jack Warlow, 3, Phillips Terrace, Twynyrodwn, Merthyr Tydvil, S. Wales, who will be pleased to send full particulars.

Cowdenbeath M.C.—A leader has been secured and with his help it is hoped that good progress will be made. Meetings are held fortnightly and Model-building occupies a large portion of the programme. A club-room has been secured at the local Y.M.C.A. The Leader, Mr. Stevenson, hopes to be able to arrange for prominent engineers to visit the club and lecture to members. *Secretary*: John Paul, Ashburn, Cardenden, Fife.

Eastham M.C.—Model-building is popular and Games Evenings are greatly enjoyed. A club library has been started and promises to be successful. An interesting debate has been held on "The Freedom of Youth." New members will be given a hearty welcome by the secretary, F. Taylor, School Lane, Eastham.

Takapuna (New Zealand) M.C.—Rapid progress is being made and all the members are very keen. A Sports Day is being arranged. The membership is very good and generally the meetings are well attended. *Secretary*: George Henwood, 56, Lake Road, Takapuna, New Zealand.

Hassocks M.C.—An adult Leader has been obtained and the club is making good progress. Meetings are held every Tuesday evening and are well attended. A competition has been held for the best built Fire Engine. Club roll: 16. *Secretary*: G. Lineham, "Park View," Keyner Road, Hassocks.

Dalston M.C.—An adult Leader has been secured and it is hoped that affiliation will be obtained in the near future. Leader: Mr C. H. Moss, 191, Dalston Lane, London, E.8.

Waterloo (Liverpool) M.C.—A very successful club has been formed and a club-room obtained. A Leader has not yet been secured. *Secretary*: T. G. Mercer, 1, Sweden Grove, Waterloo, Liverpool.

Sutton (Surrey) County School M.C.—Has now about 30 members. An enjoyable visit was paid to the London Works of the Vacuum Oil Co. Ltd., members being conducted round by the Manager. A Model Motor Evening proved very successful. Mr. A. S. Bibby has accepted the Leadership and application for affiliation will be made shortly. *Secretary*: A. G. Moore, 163, High Street, Sutton, Surrey.

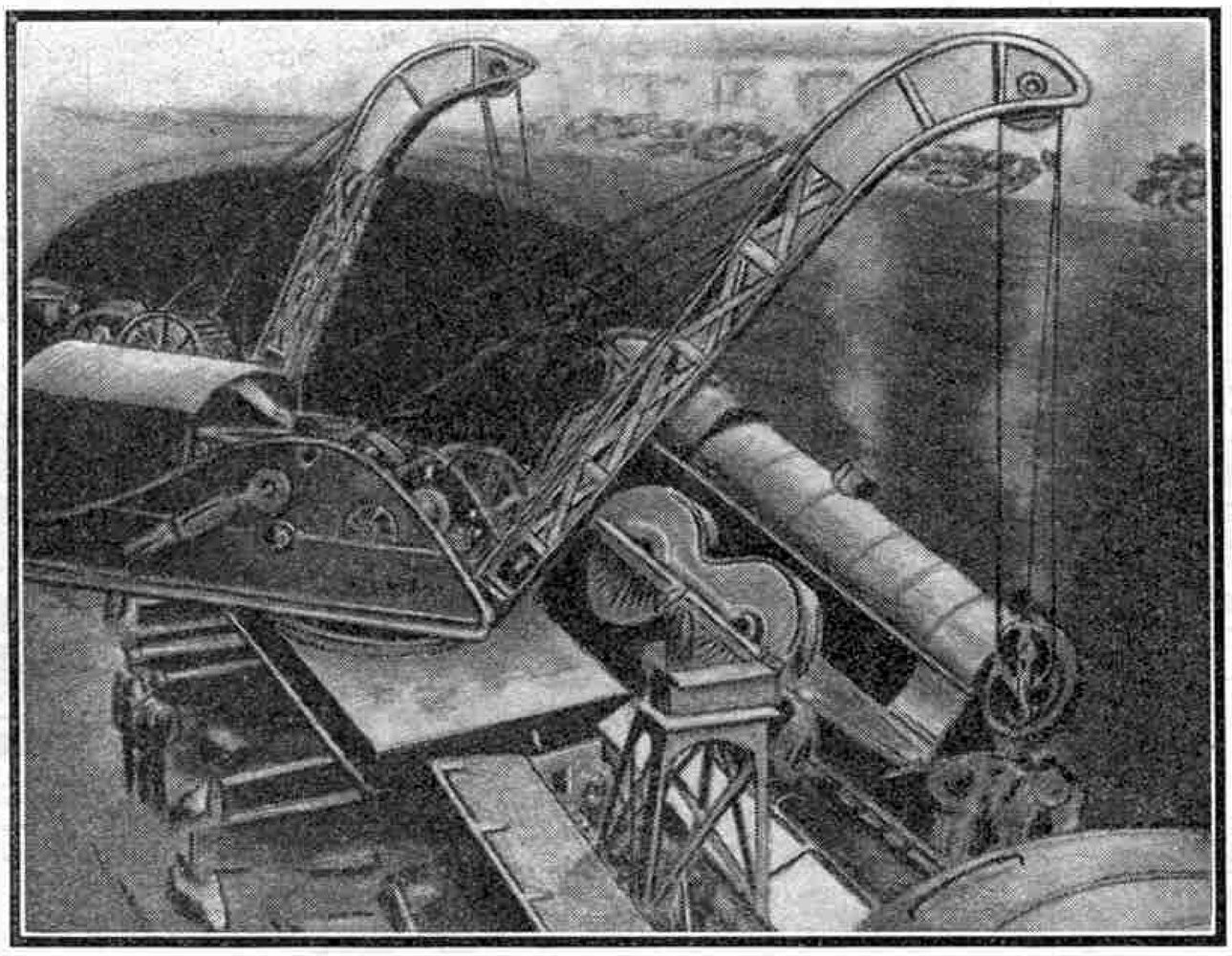
Reading School M.C.—Has held a very successful Exhibition, many excellent models being displayed. Two Meccanograph models were on view and many designs were made. A Horizontal Engine constructed in the latest Meccano parts was very striking. A talk on "The History of Meccano" was given by a senior member during the exhibition, and was well received. Several copies of the "Meccano Magazine" are secured each month and circulated among the members. Club roll: 30. *Secretary*: R. Mansell-Owen, Reading School, Reading.

Memorial (Hull) M.C.—Very good progress is reported and a Leader has been secured in Mr. Steel, of 176, Clumber Street, Hull, and it is hoped that he will very soon apply for the club's affiliation with the Guild. Fortnightly meetings are held and are proving successful. An interesting syllabus has been arranged and includes a Wireless programme, a Chat on Photography, an Adventure Story Evening and Model-building. Intending members should communicate with the *Secretary*: Philip Gambie, 53, Albany Street, Hull.

Bootle M.C.—Meetings are held at the home of one of the members, but a club-room is to be applied for in the local school-room. In a recent Model-building Contest the winning model was a Racing Motor. A Leader has not yet been secured. New members will be made welcome. *Secretary*: Jim Dempsey, 403, Stanley Road, Bootle.

Swadlincote M.C.—Is meeting regularly and all members are very enthusiastic. New members will be welcomed. *Secretary*: R. W. Moore, "Summerfield," Wilmot Road, Swadlincote, Burton-on-Trent.

Breakdown Cranes at Work



A clever drawing, by H. Lane of Stokesley, Yorks., awarded second prize in the "B" Section of our 20th Drawing Contest

4,000 Miles in 40 Hours—(*cont. from page* 328)

Damascus, and just at sundown, as the fortress gates were opened to admit the police camels for safe custody during the night, a convoy of tired looking mud-bespattered cars rolled up and halted beside the "Hercules," which was taxied close to the fort, to allow the passage of these animals which for centuries have linked up many isolated areas. Here many miles from civilisation were gathered together the most ancient, the plebian, and the most modern means of transport yet devised.

The following morning a start was made for Baghdad West aerodrome, which is within a few minutes of that interesting and mysterious city. Here Sir Sefton Brancker left us, but picking up another passenger, our first from Baghdad, departure was made for Basra, Imperial Airways temporary headquarters.

On arrival after 11½ hours' flying from Cairo the machine was handed over to the ground staff and the passengers bid a final farewell to the sturdy craft which had brought them such a colossal distance in so short a space of time without a hitch—4,000 miles in just under 40 hours' flying.

Here the "Hercules" remained to greet its third sister passing through on its way to India with Sir Samuel and Lady Hoare and party, and to await the 7th January, on which date she carried the first West-bound Mail to Cairo, thereby opening the service and forming another invaluable Empire link.

Costly Kitchen for New Liner

Landsmen often ask why the cost of new passenger vessels runs into millions, saying that they cannot see where the money goes. An answer to this query is suggested, says *"The Ocean Ferry,"* by the specifications for such a minor item as kitchen equipment in the case of the 22,000-ton passenger liner being built at Newport News for the Panama Pacific Line's New York-California service.

The stewpans for the kitchen ranges on this vessel alone will cost £800. A single stewpan 12 inches high and about the same diameter costs £35. *"M.M."* readers' mothers, who can meet the family needs in that direction with a stewpan or two of aluminium at 5/- or so, may be inclined to question these figures.

Stewpans, like everything else aboard ship, must be substantial. Ordinary marine cooking utensils are made of copper, and are tinned inside. But they are easily dented, and it has been found by experience in the Panama Pacific service, in which a round voyage calls for 11,000 miles of steaming, that re-tinning of the utensils at the end of each voyage becomes necessary. Each re-tinning of an ordinary ship's stewpan costs about £2. Hence the upkeep of utensils through each year becomes a heavy item in overhead expense for the kitchen.

Invention of the Turbine

"Nature" took the opportunity of the recent presentation of the Kelvin medal to Sir Charles Parsons to review the development of the steam turbine and especially Sir Charles's connection with it.

It was pointed out that many patents for rotary engines were taken out during the nineteenth century, but modern turbine work begins with those of 1884. First came the patent of the Swedish engineer, Gustav de Laval, for an impulse turbine, and this was followed by those of young Sir Charles Parsons.

Of the patents of April 23rd, 1884, No. 6734 was for "improvements in electric generation and in working them by fluid pressure," and No. 6735 was for "improvements in rotary motors actuated by elastic fluid pressure, and applicable also as pumps."

The pioneer Parsons turbine constructed was a double-ended parallel-flow machine, running at 18,000 revolutions per minute, driving an armature only 2½ inches in diameter. This little machine was used in the Inventions Exhibition of 1885, and is now at the Science Museum, South Kensington.

The first turbine-driven vessel was the *Turbinia*, and this was followed by the destroyers *Cobra* and *Viper*, the cruiser *Amethyst*, the battleship *Dreadnought*, and many vessels for commercial purposes.

THERE'S "FORCE" BEHIND THAT!

Training for the Boat Race isn't all slogging. Jim knows that.

Watch him at breakfast! See him devour his plate of "Force" and milk. Hear him roar for more; there is no end to his appetite.

Big lusty chaps eat "Force." Eat it too, and join the broad-shouldered crowd that does things. Everything a fellow needs to build big muscles, everything a fellow needs for health and strength is found in "Force." Taste "Force" once, and you'll kick yourself for not having done so sooner!

Ask for "Force" NOW. Get it regularly from the nearest grocer; it's ready to eat straight from the packet, either with milk or with fruit.

FORCE

WHOLE WHEAT FLAKES
MALTED AND TOASTED

The Energy Maker

ASK THEM AT HOME FOR REGULAR SUPPLIES OF **HOLFORCE**—THE POCKET LUNCHEON, MADE WITH FORCE, EGGS, BUTTER, MILK, SUGAR AND FLOUR. SIXPENCE A PACKET, SHILLING A TIN. FOR FREE SAMPLE WRITE DIRECT TO SUNNY JIM, HOLFORCE DEPT., 197, GT. PORTLAND ST., LONDON, W.1.

Competition Page

Which were the Most Popular Covers in 1926?

In the above illustration the beautiful coloured covers that appeared on the various issues of the "*M.M.*" during 1926 are displayed in reduced half-tone facsimile form in their published order—January to June in the upper row, July to December in the lower.

Many of our readers will remember the voting contest that was held in December 1925 to decide the vexed question as to which cover was the most popular of the year, and so interesting was the resulting competition that we are sure readers will be glad to have the opportunity to decide which were the most striking of our 1926 covers.

The half-tone reproductions are intended for reference purposes only, but new readers will find them of great assistance in forming an opinion. On the other hand those readers who possess copies of the 1926 magazines will be well advised to compare the originals, for the beauty of the designs depends largely upon colouring.

Each competitor is asked to write on a postcard his (or her) idea of the order of popularity of the covers, referring to each by its month of issue. The entrant's name and address must be added to the card which should be addressed to "Cover Voting Contest, Meccano Magazine, Binns Road, Liverpool." Each list must cover the whole year and competitors may send as many entries as they wish, provided that each is on a separate card.

Prizes of Meccano goods (to be chosen by the winner) to the value of £1-1s., 15/–, 10/6 and 5/– respectively will be awarded to the competitors whose lists most accurately forecast the final order of popularity of the covers, as decided by the votes of all the competitors, and in addition there will be a number of consolation prizes.

Closing date, 30th April. Overseas, 30th July.

Competition Suggestions

It is probable that if a list of our most popular types of competitions was prepared, drawing and railway subjects would figure very prominently at the head of the list, for these are certainly among the best supported of the many different contests organised by the "*M.M.*" But it is by no means an easy task to select something new each month on either of these two classes of subjects and it is not to be marvelled at that the Competition Editor is occasionally inclined to take the view that there is nothing new under the Sun!

We are quite certain that many of our readers can suggest some novel type of drawing contest or something new for our railway competitions, and here is the chance for them to put their suggestions forward.

Prizes of Meccano or Hornby Train goods to the value of £1-1s., 15/– and 10/6 are offered to the readers who submit the best suggestions for new contests of the type mentioned above. The suggestions need not be in the form of long essays, as the basis of the awards will be the soundness of the ideas put forward but each suggestion must be accompanied by a full explanation. Entries must be addressed to "Competition Suggestions" and sent to reach this office not later than 30th April. Overseas closing date, 30th July.

Home Results

Feature Voting Contest

With so great a list of regular features from which to choose, it was, perhaps, hardly surprising that our readers' individual choice, and their forecasts of the final order of popularity varied considerably. That fact, however, reflected a great testimony to the range of subject matter offered in the "*M.M.*" Each feature proved to be somebody's favourite.

Our newest feature, "Famous Trains," proved easily the most popular item and polled five times as many votes as any other item but the competition for the remaining places in the list of eight was exceptionally keen, and only twenty votes separated the second from the eighth. As the Overseas section is still open, we refrain from giving a detailed commentary.

The prize list is as follows:—1, J. Mercer (Dalkeith); 2, G. S. Parker (Nr. Bath); 3, B. O. Laramy (N. Devon). Consolation Prizes: S. Broadhurst (Co. Durham); F. Burt (Birmingham); L. G. Haiste (Leeds); P. Hawkins (Hampshire); E. F. M. Poole (Malvern); F. Walsh (Eastbourne).

21st Drawing Contest

The advantage of having an actual photograph of the subject to work from was clearly shown by the entries for this contest, the subject of which was "The Rotor Ship." It was, of course, to be expected that the majority of the drawings submitted would be straight copies of the picture available. Many entrants, however, preferred to work on their own lines and placed the "*Barbara*" in an entirely new setting; other drawings ignored the "*Barbara*" entirely and incorporated the main features of the rotor ship with vessels of entirely different design.

Taking all into consideration, this contest has been highly successful and the winners are worthy of the prizes. The following are the awards:—First Prizes: Section A, T. O. Dawson (Tyldesley); Section B, C. A. Burton (London, S.E.18). Second Prizes: Section A, A. Hunt (Bristol); Section B, W. F. Scudder (London, S.E.12). Consolation Prizes: Section A, F. Herriott (Peebles); Section B, T. McCrea (Greenock); R. C. Randall (St. Albans); F. Tridgett (London, N.8).

My Hornby Layout

The entries for this contest are so numerous, and the task of judging so complicated, that it has been found impossible to complete the work in time to permit the results to be announced in this issue. A full commentary and list of awards will appear next month.

February Stamp Contest

There was an excellent entry for this competition, but, strangely enough, the number of competitors to provide completely accurate solutions was the lowest of any of the present series, the actual number being thirteen. Obviously someone had to be unlucky but really the most unfortunate person in this instance

(*Continued in col.* 1, *page* 359)

Fireside Fun

PROBABLY SO!

Going through his usual duties one Monday morning, a rent collector called at the house of Mrs. Slowpayer. Master Slowpayer opened the door and, with the air of one who had learned his message well, said: "Mother and Father's out. Will you please call on Friday?"

"H'm!" said the collector. He would have said more but it did not seem of much use. Suddenly a thought struck him. "And why on Friday, my little man?" he asked.

"I don't know," was the reply. "Perhaps it's because we are going to move on Thursday!"

* * * *

An Englishman once lost himself in a mist on a Scottish moor. He met a native and said:—"I am lost."

The native replied:—"Is there any reward for findin' on ye?"

* * * *

A country constable had accused a motorist of exceeding the speed limit. The magistrate, calling for evidence, asked, "Constable, can you tell me at what speed the defendant was travelling?"

"Well, indeed sir, I do not know. He was going so fast I did not see him till he was out of sight!"

* * * *

IN SAFE KEEPING!

One day a boy's mother said to him, as she handed him half-a-crown: "Go, Tommy, buy a pennyworth of sweets and bring back the change to me."

Night came and the boy did not return, so his mother and father took a lantern and went in search of him. They found him standing by a slot machine.

"Why didn't you come home?" asked his mother.

"Oh, I am all right," replied Tommy. "I put in 2/6, and I am waiting for the change!"

FROM THE LIMERICKS COMPETITION

A Meccano boy living at Cirencester
Had a sister, till one day he mirencester,
But he found she was shut
Twixt a bolt and a nut,
So he carefully had to untwirencester.

* * * *

Q. Why did the oxide?
A. Because the acid.

* * * *

MORE INTERESTING!

An American on a visit to London went to the Zoo. Approaching one of the keepers he said to him "Say, keeper, I want you to take me right along to your head man, so that I can talk business to him."

The official eyed him suspiciously.

"And what sort of business do you want to discuss?" he asked.

"Wal, it's like this," explained the American, "I've taken a great fancy to this l'il exhibit, and I want to buy the Zoo for my kids."

"Nothing doing in that line," answered the keeper, tersely; "but I'll tell you what we might do. We might buy your kids for the Zoo!"

* * * *

WRONG AGAIN!

A farmer had built a big barn. One day, as he was setting off for town, he told his two sons to cut a small hole in one of the sides so that the cat could get in or out at will.

The boys cut the hole just beside the barn door, but when the father returned and saw it he was annoyed.

"I can't depend on you boys to do a single thing right!" he exclaimed angrily. "Don't you know that hole is in the wrong place?"

"Why?" asked his sons.

The farmer seized the barn door and swung it wide open, and, of course, it covered the aperture. "Now, where is your hole?" he shouted. "How can the cat get into the barn when the door's open?"

THE PARSON'S EGG!

Papa: "Well, Johnny, you went to church this morning?"

Johnny: "Yes, Papa."

Papa: "How did you like the sermon."

Johnny: "The beginning was good, and the end was good, but there was too much middle in it, papa."

* * * *

Mistress, to Irish maid: "What, reading with two candles?"

"No, mum, not at all—only one, but I cut it in half!"

* * * *

"I see you advertise for a donkey!" said the man who looked as if he had something for sale.

"Oh, yes," said the busy man, stopping his work for a minute to look up, "but I want one with four legs!"

* * * *

A youth of decided literary tastes walked into the village general store—it happened also to be the bookshop—and asked "Have you Scott's 'Ivanhoe'?"

"No, sir!" was the reply.

"Then perhaps you have Scott's 'Kenilworth?'" he asked.

"No sir," came the triumphant reply, "but we have his 'Emulsion'!"

* * * *

SOME PULL!

Jack and his father were weeding in the garden one day, and Jack happened to root up a big one with lots of earth on it. "Gosh, Dad, ain't I strong?" he cried.

"My word, yes!" his father replied.

"Why," continued Jack," the whole world was pulling on the other end of it."

* * * *

The curate was visiting the house of one of his parishioners, and while waiting to see his hostess he took her little daughter upon his knee. This she resented and endeavoured to escape. As the curate released her he said, "You know, Mary, I do not love you." To his amazement the little one replied, "And why not? You ought to." Vastly amused the curate inquired, "Why?"

The answer came quickly. "Because God says that you ought to love those that hate you, and I hate you."

OH, LAW!

The tramp trudged up to the door and knocked. It opened and out came a burly officer of the law. The tramp shuffled his feet uneasily and then said, "Er—Please sir, I have come to tell as how I ain't—er—had nothing for two days and don't want nothing now."

* * * *

Two Officers walked into a hotel in Salonica and ordered Turkey without Greece. "I am sorry," said the waiter, "but I cannot Servia." "Oh," replied the Officers, "then you must call your Bosphorus." The head waiter came in and said, "I do not want to Russia, but you cannot Rumania." So the Officers had no dinner.

* *

Patient: "I am a little better now, doctor, but I'm still short of breath."

Doctor: "Just have patience, my man, and I'll stop that."

* *

The chauffeur was holding forth in the village inn.

"Yus, my young guv'nor rowed for Hoxford, 'e did. Wins 'undreds of races and always 'as the name an' the date of the race painted on 'is skull."

"On 'is skull!" ejaculated Mr. Swiller. "Lumme! 'e must 'ave an 'ead like a nelephant."

* *

Patron: "Waiter, what is the matter with this establishment? This steak is burnt black."

Waiter: "Yessir—mark of respect, sir. Our head cook died yesterday."

* * * *

Mu'e: "What on earth are you?"
Ford Car (haughtily): "A car, of course."
Mule: "Well then, I'm a horse!"

* * * *

TWO OF THEM

The Boss: "Now, James, we've forgotten to get some stamps!"

Office Boy: "There, sir! Aren't we a couple of thickheads?"

* * * *

Charlie had just commenced his apprenticeship in the local stores. He was not a very bright boy, but he had always an answer to every complaint. One day Charlie was endeavouring to persuade an old and extremely fussy lady to purchase some strawberry jam. After carefully scrutinizing the maker's label, the customer inquired if the jam was new.

"Heavens," gasped Charlie. "Of course it's new! Do you think we sell second-hand jam?"

TOO BAD

A man, asking a friend of his for an appointment, received the following cryptic note:

"See you to-morrow. Shall be in from 2 2 2 2 2 2 2 at 2 2 2 2-ting Broadway." What did the friend mean?

It is so very simple when you look at it in the right way. He meant, "Shall be in from two to two to two-twenty-two at 222 Tooting Broadway."

* * * *

Magistrate: "Can't this case be settled out of court?"

O'Halloran: "That's just what we were trying to do, yer honour, when the police interfered."

Courtesy] DISCOMFORTS OF PRE-HISTORIC AIR TRAVEL [*Gloster Aircraft Co. Ltd.*

"Did you behave?" asked an interested relative when Jack returned from church.

"Course I did," replied Jack. "I heard the lady at the back of us say she never saw a child behave so!"

* * * *

A QUIET START!

Parliamentary Candidate: "If you return me to the House my voice will ring from Lands End to John o' Groats; aye, from Dan to Beersheeba."

Voice (from back of hall): "Speak up, guv'nor."

* * * *

Colonel (relating adventure): "And when I fired, the lion was ten thousand feet away!"

Friend: "And did you hit him?"

Colonel: "No, but think of the distance!"

* * * *

Artist: "You know that last painting of mine? I've sold it to old Tightfist for a thousand guineas."

Friend: "Good! I'm pleased to hear it. He deserves to be swindled."

SHE KNOWS NOW!

"What is the meaning of that big 'D' on the dustbin?" asked the new servant.

The haughty footman replied as follows: "Damsel, the 'D' displayed on the dustbin denotes that the despairing domestics of this detached domicile desire that the deserving dustmen during their daily diversions will deem it their delightful duty to dislodge deliberately and deftly the dirt and dust deposited in that disagreeable dustbin."

* * * *

"I get Honolulu, Peru, Moscow, and Dresden on my wireless set."

"Do you keep the windows open or closed?"

* *

An Arab sheik was being taken in a Ford car across a very bumpy patch of desert in Transjordania. So bad was the going that at last the car overturned and the sheik was thrown out.

Instead of turning in wrath upon his driver the Arab picked himself up and apologised profusely saying, "I'm so sorry. I have not learned to ride one of these things yet."

* *

"I don't see any use of my son, Benjamin, studying Latin," said a certain honest agriculturalist addressing the principal of the village academy.

"But, my dear sir," expostulated the man of letters, "Latin is one of the foremost essentials of a liberal education. It broadens the mind, strengthens the intellectual grasp, and —"

"Tut, tut! what I want him to learn is something that will strengthen his financial grasp, so to speak. Latin is one of the dead languages, isn't it?"

"Yes, but —"

"Very well, then, it won't be of no manner of use to Benjamin. He's going to be a farmer, ye see, not an undertaker!"

* * * *

AT CLOSING TIME!

Scene, a Highland grocer's shop. Father's voice heard from back parlour to daughter in shop.

"Hae ye dampit the tobaccy, Maggie?"
"Aye, faither."
"And sanded the sugar?"
"Aye, faither."
"Weel, come ben to worship."

* * * *

A lump of rough light red leather, a red light rough leather lump.

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This wonderful gift packet contains 2 Jamaica (pictorial), 5 Australia, 1 Malay (tiger), 10 Canada, 1 Cochin (rajah), 1 Deccan, 4 Ceylon, 1 Gold Coast, 1 Nigeria, 1 Travencore, 4 New Zealand, 1 Queensland, 1 Straits, 5 Union South Africa (including new issue), 9 Irish (set with high values). ABSOLUTELY FREE TO GENUINE COLLECTORS REQUESTING APPROVALS. Also those sending 3d. for postage, etc., receive fine set of 100 unused German, all different.

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N **ISSUES**
E **COLOURS**
W **VALUES**

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This packet contains 100 all different Stamps catalogued from 1d.–5/- each, such as War, Revolution, Armistice, Provisionals, Pictorials, Long and Short Sets, Used and Unused, all in perfect condition. There are 5 different packets, all entirely different from each other (i.e., no two stamps alike in the 5 packets). 1 pkt. 1/3, 2 pkts. 2/5, 3 pkts. 3/6, 4 pkts. 4/7, 5 pkts. 5/6. All post free. Satisfaction guaranteed or money returned.

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---

13 Mozambique Company Free.

To all sending 2d. (Overseas 3d.) for postage of my new 64-page Price List of Packets and Sets from 1d. up, Albums from 1/- to £4, Books about stamps from 6d. up, Outfits and Accessories of all kinds, fully illustrated, will be sent the above 13 different Mozambique Company stamps. This is a beautiful set, mostly in two colours, and depicts East African Natives, Ivory, Tobacco, Cotton, Coffee and Maize crops, View of the Port of Beira, Native Village, Coat of Arms with Elephant Supporters, etc. Ask for the No. 2 Packet, and don't forget the Postage. In addition, for RESPONSIBLE approval applicants only, 2 TRINIDAD (large stamps) FREE.

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1000 ALL DIFF. GENUINE STAMPS

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BARGAIN PRICE 3/- Postage 1½d. extra.

This is a collection of 1,000 DIFFERENT STAMPS from a GREAT MANY COUNTRIES. Even if you already have a large collection you will probably find many hundreds you have not got. THERE IS NO CATCH—Just a straightforward offer of a FINE VARIETY of PERFECT, GENUINE STAMPS at the price of a bag of mixed.

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100	Europe	...	3d.	100	Africa	...	2/-
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200	,,	...	9d.	150	,,	...	4/6
250	,,	...	1/-	25	America	...	3d.
300	,,	...	1/6	50	,,	...	7d.
350	,,	...	2/-	75	,,	...	1/-
25	Asia	...	3d.	100	,,	...	1/6
50	,,	...	8d.	125	,,	...	2/6
75	,,	...	1/-	150	,,	...	3/9
100	,,	...	1/3	25	Oceania	...	4d.
125	,,	...	2/-	50	,,	...	9d.
150	,,	...	3/-	75	,,	...	1/4
25	Africa	...	3d.	100	,,	...	2/3
50	,,	...	8d.	125	,,	...	3/6
75	,,	...	1/3	150	,,	...	5/-

Sheets of Postage or Fiscal in separate countries.

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A set of Handsome Stamps from this **British Protectorate** in the Pacific, sent free of charge to bona-fide applicants for approval selections. Low prices. Big discount. If 2d. is enclosed for postage 1,000 Stamp Mounts also given free.

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20 grand pictorials including Germany (aeroplanes), Jugo-Slav (chain breaker), Mozambique (pictorials), French Cols. and other good varieties. Just send a p.c. requesting approvals and this gift will be sent by return. Beginners' Album holds 2,000 stamps, 1/3 post free.

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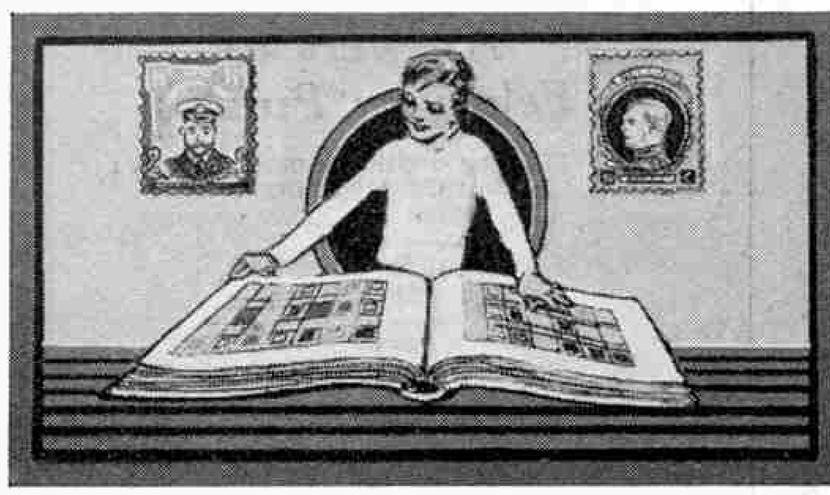

Stamp Collecting

GODS AND GODDESSES OF GREECE

By R. Kay Gresswell

IN our recent stamp articles we have dealt with a selection of the many interesting stamps that bear portraits of famous historical characters. Stamp portraits are not confined to such characters, however, for when we turn to the stamps of Greece and Crete we find portrayed many of the outstanding figures of Greek and Roman mythology.

The most frequent figure to be found on such stamps is Hermes, the god who looked after travellers and messengers, and who, if he were worshipped to-day, would naturally be regarded as the god of the posts. We find Hermes, who is the same as the Roman god Mercury, portrayed on several stamps of Greece, of which we illustrate four. His profile facing right is to be found on the 1886-99 series of which we show the 1 l. This stamp was designed by M. Hendricks and engraved by A. Doms, the printing being done first at the Belgian Stamp Printing Works, Malines, and later at Athens. The two printings may be distinguished by the fact that the Belgian printings are much finer and are on much better paper than the Athens printings.

The next stamp showing Hermes that we illustrate is the 1 l. of the 1901 issue. This series of stamps was printed by Messrs. Perkins, Bacon & Co. of London, on paper watermarked with a small simple crown and large outline letters "ET" on each stamp. There were two types, the second one showing the same figure of Hermes but with a different frame. This figure is copied from the famous statue of Mercury by Giovanni da Bologna.

Certain values of the 1911 series of stamps also show Hermes on four of the five types. The type used for the 1, 3, and 10 l. values is a portrait facing right, with a somewhat unusual type of hat for this god. The 25 dr. value also shows the same portrait and might be considered to be the same type, excepting that it is larger than the first type. The 5, 30 and 50 l. values show the god apparently binding his foot with what is probably a leathern thong. Lastly, the 1 to 10 dr. values show Hermes holding up the god Arcas. Of these four types we illustrate all but the second mentioned above.

The God of Travellers and of Thieves

Hermes was the son of Jupiter and Maia, and when he grew up he was appointed by his father to be the herald and messenger of the gods. He was the god of travellers, shepherds, orators and merchants and, most remarkably, of thieves, pickpockets and other dishonest persons! Hermes appears indeed to have been one of the most versatile of all the gods, for in addition to other matters he was regarded as the creator of weights and measures and of numbers and the alphabet.

Hermes received from Apollo, in exchange for the lyre that he had invented, the famous caduceus or wand that appears on all his portraits. This wand or rod is usually surmounted with two wings and entwined by two serpents, and it appears on very many different stamps of the world. It should be noticed, however, that the serpents are absent in the 1911 issue of Greece that we have described.

Iris, the Rainbow Goddess

Another messenger of the gods is the goddess Iris, who was a daughter of Thaumas and Electra. Iris is shown on the 2, 20, 25 and 40 l. values of the 1911 issue of Greece that we have already mentioned. This issue was engraved by Mr. Thomas Macdonald and printed by Messrs. Aspiotis of Corfu.

While Iris was a messenger of all the gods, she was more particularly concerned with Juno and among her duties was that of cutting the thread that seemed to hold the soul in the body of those who were dying. She was identified with the rainbow and in the stamp is shown with wings, while she holds in her right hand a caduceus similar to that of Hermes, but without the two serpents.

The Twins Apollo and Diana

The god and the goddess Apollo and Diana were twins, being the son and daughter of Jupiter. Apollo is shown on the 1 l. and 2 l. values of the 1906 Olympic Games issue. In this stamp he is shown throwing the discus, which was one of the favourite exercises of the ancient Greek athletes.

Apollo was the god of light, of the fine arts, of music, of poetry and of eloquence. He was supposed to have invented all these accomplishments, and in addition to presiding over them he had received from Jupiter the power of foretelling the future. He was the only one of the gods whose oracles were to be found all over the ancient world, those of most other gods being confined to one country only.

His twin, Diana, is shown on the 2 l. value of the 1905 issue of Crete, illustrated here. This stamp was printed by Messrs. Bradbury, Wilkinson & Co. of London, and was perforated 14. The stamp has a somewhat unique appearance giving at first sight the impression of representing a collection of bones! Actually, however, we find that it shows Diana on a pedestal round which are jumping two dogs, for Diana was the goddess of hunting, and in addition looked after the welfare of travellers at cross-roads.

Two of the World's Strong Men

Many of our school atlases show on the first page a picture of a very powerful man bent almost double under the strain of holding up the heavens. This is the god Atlas, after whom the book he adorns has been named.

Atlas was one of the Titans, a very strong race, and there are two theories as to his fate. One is that one day when he was in his palace, another god named Perseus, who was passing by, asked for hospitality. Atlas, however, had been informed by an oracle that he would some day be dethroned by one of the descendants of Jupiter, who was the father of Perseus, and accordingly he refused to entertain Perseus and even attempted to injure him. Perseus showed Atlas the head of

(*Continued on page 373*)

500 FOREIGN STAMPS 6d., 2,000 1/6, 5,000 3/6.—Cranwell, 202, Hermon Hill, London, E.18.

100 DIFFERENT STAMPS FREE. Send for ½d. approvals.—Cox, 135, Cambridge Road, Seven Kings.

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100 DIFFERENT STAMPS FREE
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To applicants for my famous ½d. approvals. 100 different Stamps, including B. Colonials, S. American, Chinese, etc. Without approvals this packet may be had for 6d. post free.— **S. H. Fleming, St. Winifreds, Christleton Rd., Chester.**

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Hundreds of old sets, sheets, and odd Stamps removed from collections, etc. Made up into parcels at 2/–, 5/– and 10/–. Excellent value, one or two stamps alone worth the money. Would show a good profit if resold. Money willingly refunded if not amply satisfied, also every kind of good class approvals and packets, in fact everything philatelic at prices far cheaper than any other dealer. Juniors packets and approvals my speciality.—**E. BRISTOW, 22, Malden Hill Gdns., New Malden, Surrey.**

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J. & F. RYDER,
38, Clifford Street, Brooks's Bar, Manchester.

SARDINIAN PACKET FREE
A grand packet of 25 **Different Stamps,** containing **Sardinia** unused, a fine **Set of 4 Algeria 1926, Transvaal 1896 1d. Unused,** a fine stamp, **Kenya and Uganda 20c. Epirus** Flag Issue, **Persia 1889,** a fine pictorial **Libya** unused, **Eritrea, Porto Rico** head, **Monaco** new issue, **Syria** pictorial, **Cape Verde, French Guiana** pictorial, **Ivory Coast** pictorial, **Madagascar** pictorial, **Reunion** pictorial, etc., etc., to all asking to see my famous Approval Sheets and enclosing 2d. **for Postage and Packing (Abroad 3d).**
S. HAMMOND, 2, CHESHAM FIELDS, BURY.
STAMP COLLECTIONS PURCHASED.

My Record Selections on approval at the huge discount of 8d. and 9d. in 1/- off Gibbons Catalogue Prices. Mostly British Colonials. These are indeed a record of quality and cheapness, and I have many unsolicited testimonials to that effect. These contain stamps of very good quality and not the rubbish that is often put on approvals, such as cheap South Americans, etc., and **only 6d. in 1/- discount** allowed off same. This is why I give no **Free Gifts.** But you save pounds by buying from me, owing to the big discount I offer and the superior quality stamps that my selections contain. Kindly state whether cheap, medium or rare stamps are desired. Cheap selections contain stamps up to 3/- catalogue, Medium up to 10/- catalogue, Rare up to £6 catalogue each stamp. **References required from those applicants who want rare stamps.—Record House, 23, Canning Road, East Croydon, Surrey.**

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Method of adding to your collection. When you buy PACKETS you buy DUPLICATES. I will send you a book of 1,111 different stamps from which you may select any 100 for 3/–.
BUY ONLY THOSE YOU REQUIRE.
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Recent Issues

HUNGARY: Charity Sports Issue

During 1925 Hungary issued a series that will appeal to all Meccano boys, even to those few who are not stamp collectors, for the subjects of the designs are different sporting scenes.

There are eight values, all perforated 12 between. The lowest value, 100 korona (brown and green) shows a company of athletes marching four deep past a grandstand at an Olympiad. The 200 kor. (green and brown) shows a man ski-ing over snow-clad mountains. The 300 kor. (a beautiful shade of blue) shows ice figure-skating in progress, the background being occupied by an elaborate domed building. The 400 kor. (green and blue) we illustrate, and, as will be seen, it typifies diving, swimming and rowing. The 500 kor. (slate-purple) shows two men in a characteristic fencing attitude. The 1000 kor. (claret, illustrated) shows a Boy Scouts' camp with a bugler in the foreground. The 2000 kor. (purple) shows the goal-keeper leaping at the ball in a game of football, and the 2500 kor. (sepia) illustrates hurdling.

This series, which was sold at double of the face value in aid of various sports associations, is one of the best and most interesting we have seen for some time and we strongly advise all our readers to make a point of having it in their albums.

BELGIUM

Owing to floods having inundated large tracts of country, Belgium surcharged the current 30c. stamps as shown in the illustration, so that the cost of the stamp became 60c., 30c. of which was for use as postage and the other 30c. for the relief of those who had suffered owing to the flooding.

The stamp was issued in 1926, the surcharge being in red and the stamp itself in pale blue-green. We have no information as to whether the use of this stamp was compulsory, but we do not think that this was the case, as forced charities are both unfair and undesirable.

Answers to February Puzzles

No. 208. The long division sum is as under:

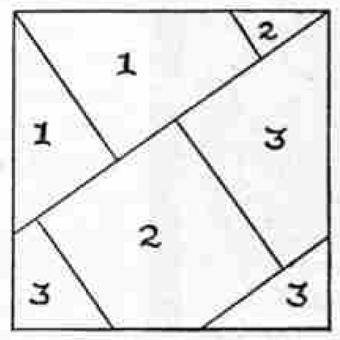
```
956)58700312(61402
    5736
    ----
     1340
      956
     ----
      3843
      3824
     ----
       1912
       1912
      ----
       ....
      ----
```

* * * *

No. 209. 5; The locomotive proceeds to B and coupled up it reverses to C and proceeds to D, leaves the truck and returns to C. It proceeds to A and pushes the truck to D. Both trucks are now coupled, B being uncoupled at A and A at B.

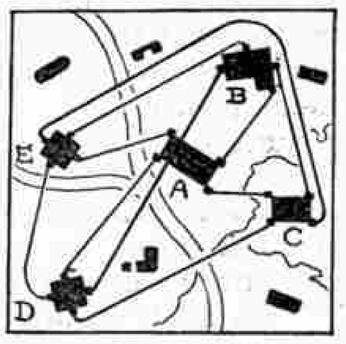
* * * *

No. 211. The square is divided as shown in the diagram below, the numbered parts being those of the respective squares.



* * * *

No. 212. The diagram below shows how the telephone lines were arranged.



* * * *

No. 213. 3½". It should be remembered that the first page of volume one is nearest to volume two and that the last page of volume three is the nearest to volume two.

* * * *

No. 214. Their profit was 1d. less than they anticipated because on the previous occasion there were 25 transactions at 1d., while on the second occasion there were only 12 at 2d.

* * * *

No. 215.

$$\frac{96 = 16.}{6}$$

* * * *

No. 216. The names of the locomotives are as follows:—Lord Nelson, River Frome, Pendennis Castle, King Arthur, Sir Bedivere, Tintagel.

* * * *

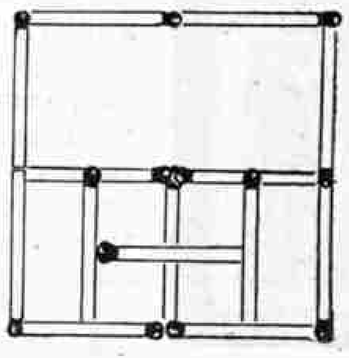
No. 217. Meccano.

* * * *

No. 218. Cornish Riviera.

* * * *

No. 219. The matches were arranged as shown in the diagram below.



(*Continued from page* 371)

Medusa, whom he had just killed. Atlas was immediately turned into stone and was converted into a range of mountains—the Atlas Mountains that stretch across northern Africa. The ancients imagined that the heavens, that is the skies, rested upon the tops of these mountains and that Atlas thus supported the world on his shoulders. Another story is that Atlas led the Titans in a war against the gods, for which the latter punished him by condemning him to bear the heavens on his shoulders.

Atlas is also shown on the 20 l. value of the Olympic games series, illustrated here. In this stamp we see Atlas passing to Hercules the golden apples from the Garden of the Hesperides. Hercules had been condemned to carry out twelve prescribed tasks or labours in atonement of a deed of violence, and the eleventh of these labours was to procure some of the golden apples that Juno had given to Jupiter as a wedding present. These apples were guarded by the Hesperides, who were three nymphs, daughters of Hesperus, and by a ferocious dragon who never slept. The task was accomplished by Hercules holding up the heavens for Atlas while the latter obtained the apples.

Hercules and Antaeus

Hercules is shown on another value of the same series of stamps, this being the 25 l. which we also illustrate here. This stamp depicts the struggle between Hercules and Antaeus, a giant of Libya in northern Africa.

Antaeus was a very great wrestler and he compelled all strangers passing through the country to wrestle with him. He was always victorious because his mother was Terra, the Earth goddess, and therefore whenever he was thrown he derived fresh strength from contact with the ground. We are told that he had conquered and slain so many men that he erected with their skulls a temple to his father! Hercules by some means became aware of the source of the extraordinary strength of Antaeus and he vanquished him by lifting him from the ground and crushing him to death.

The remaining values of this 1906 series show on the 10 l. victory; on the 30 l. wrestlers; on the 40 l. Hermes with the various symbols of games and fetes; on the 1, 2 and 3 dr. a race between four ancient Greeks, and on the 5 dr. gods and goddesses bringing offerings for the Olympic Games that the series commemorates. The whole series was printed by Messrs. Perkins, Bacon and Company of London, and it makes a most interesting page in the album, especially if a few words are written alongside each type describing who the particular god or goddess is and for what he or she is famous.

Britomartis

Turning again to Crete, we find on the 5 l. value of the 1905 issue the well-known Britomartis, who, according to legend, was the most beautiful nymph of Crete. Britomartis was the daughter of Jupiter and she devoted herself to hunting. On one occasion she was pursued very closely by her lover Minos, King of Crete, and in order to avoid him she threw herself into the sea. We are told that she escaped drowning owing to the fact that she jumped into the nets of some fishermen who were below the rock from which she leaped. Britomartis was the patroness of hunters, sailors and fishermen, and was a goddess of birth and health.

Perseus and the Gorgons

Turning now to the stamps of other countries, it is interesting to discover that the head of Medusa, to which we referred in an earlier paragraph, is depicted on the first stamps of Naples, issued in 1858. The design of these stamps incorporates the arms of the two Sicilies, composed of the horse for Naples, the three legs and the head of Medusa for Sicily and three Fleurs-de-lis for Bourbon. These stamps will remind readers of the familiar three legs associated with the Isle of Man.

Medusa, so the legend runs, was a very beautiful maiden, but she was unfortunate enough to offend Athena, the Goddess of the Air. In revenge Athena changed Medusa's hair into writhing snakes and made her appearance so hideous and so terrible that all who looked upon her face died instantly, being turned to stone! Medusa became one of the evil Gorgon sisters, who were reputed to haunt the cliffs of the Western Ocean and represented in mythology the evil spirit of the thunder clouds.

Perseus penetrated to the dreadful cave of the Gorgons and succeeded in cutting off the head of Medusa by using his shield as a mirror, thus avoiding the fatal consequences of looking directly into the terrible eyes. He bore off the head of Medusa in triumph to Athena, who mounted it upon her shield.

Many pleasant evenings may be spent in looking at the stamps we have described and the many others that are to be found depicting the famous characters of Greek and Roman mythology, and in reading the interesting and wonderful legends with which they are associated. A fascinating study of imagery can be developed thereby.

OUR MAIL BAG

In this column the Editor replies to letters from his readers, from whom he is always pleased to hear. He receives hundreds of letters each day, but only those that deal with matters of general interest can be dealt with here.

Correspondents will help the Editor if they will write neatly in ink and on one side of the paper only.

Neale (Stourbridge).—Your postal order has been received but unfortunately we have mislaid your letter. Will you please send your address so that we may write you.

M. C. Hodder (Exeter).—"The Meccano Guild will I hope, in time be a useful adjunct to the League of Nations. Personally I have given up the idea of ever attaining world peace with the older generation. The Guild spirit is bound to yield good results in later life, when possibly some present Guild member will be Prime Minister and other Guild members become Cabinet Ministers and M.P.'s." If at some future day any of our boys find themselves concerned with the affairs of the country, we hope they will add the words of a great man to their Guild "objects," "With malice towards none, with charity for all, let us . . . . . do all things that may achieve and cherish a just and lasting peace among ourselves and with all nations." We wonder how many readers can fill in the missing sentences from this quotation, and tell us with whom it originated.

J. E. Govan (Edinburgh).—"Please don't let the 'Stamp Collecting' drop out of the '*M.M.*' I say this because lately this section has been getting nearer and nearer the end." You need have no fears on this account, the "retreat" of the stamp section has been purely "strategic," and there is no fear of the section passing over the frontier and escaping by way of the back cover! Your comments regarding the Competition Page are interesting. We hope in future to have more competitions dealing with aeroplanes and railways. We are afraid the "Suggestions" and "Standard Mechanisms" section cannot be extended at present but this may be possible later.

R. Feakin (Coleshill).—Your idea of reserving a corner in the "*M.M.*" for publication of suggestions for articles, with the object of inviting the opinions of readers, is quite good and we shall seriously consider its adoption. The "*M.M.*" appears to have caused some excitement at your lodgings! This kind of thing occurs very often. People who have either never heard of the "*M.M.*," or perhaps have regarded it as a "mere children's paper," get hold of a copy and in a few minutes they are converted and bubbling over with enthusiasm!

J. G. Miller, J. L. Robbins and L. F. Hall (London, N.W.2).—Your joint letter was specially welcome on account of its practical nature and your various suggestions for the improvement of the Hornby Railway system are having careful consideration. We are glad to hear of your two No. 2 locos that have been in regular use since 1922 and 1924 respectively. We are constantly receiving similar testimonials to the remarkable durability of the Hornby engines.

A. M. Johnston (Dunstable).—You and your brother evidently own a very fine Meccano Outfit and we hope that now you have commenced taking the "*M.M.*" you will both enter for some of the Model-building Competitions. We agree that some of the models in the Manual of Instructions scarcely do justice to the outfits, but it must be remembered that these models have been selected for the purpose of showing how Meccano is utilised in structures of widely different types. In short, the models are examples only, and have not been devised with the object of showing the utmost capabilities of the various outfits.

J. C. Heath (Wellingborough).—"I consider that the '*M.M.*' is the best Magazine in the world for boys. Since I had it, three years ago this month, I have encouraged nine boys to take it and they all think it excellent." Well done, J.C.! If every reader of the "*M.M.*" did likewise, what a circulation we should have!

N. Martin (Exeter).—"Now that I am in hospital I can't do without my Magazine. This month mother couldn't get it for a couple of days after publishing day and I was so downhearted over it that I went back, but as soon as I caught sight of the nurse bringing it to my bed I was quite a different boy! It is a wonderful Mag.; it absolutely can't be beaten. I argue with anybody over that and if that doesn't convince them I use my fists!" Many thanks for your cheery letter. We hope by this time that you are fully recovered, and from what you say the "*M.M.*" appears to do you quite as much good as the doctor's medicine! We quite agree that it is a "wonderful Mag.," but, Norman, you really must not use your fists; stick to peaceful persuasion!

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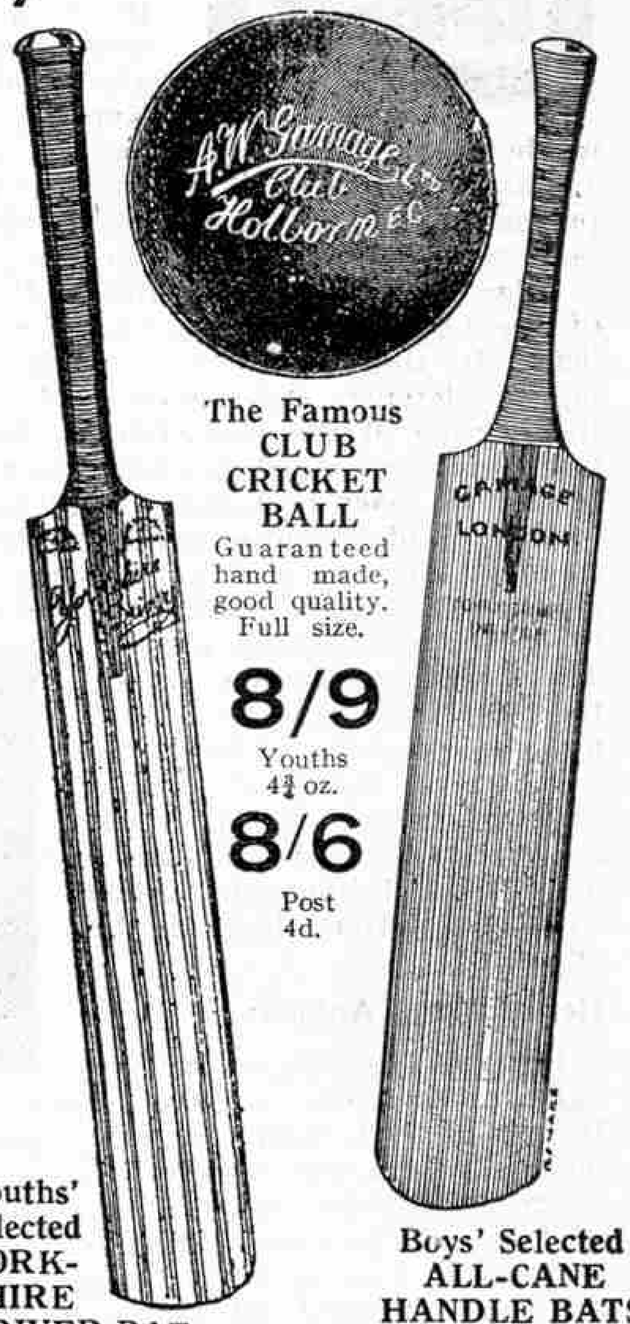

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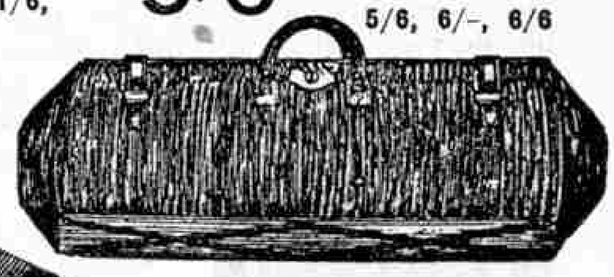

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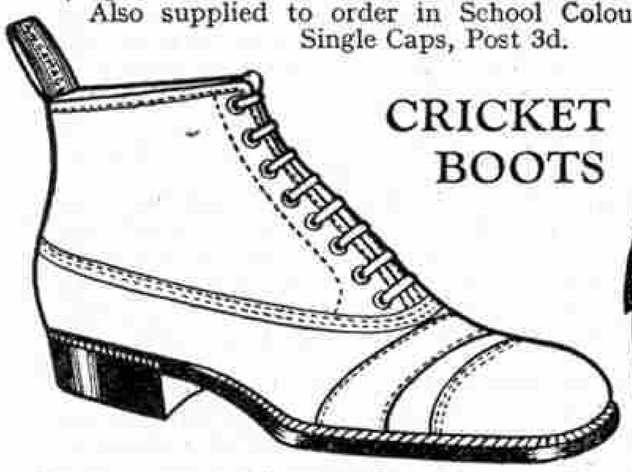

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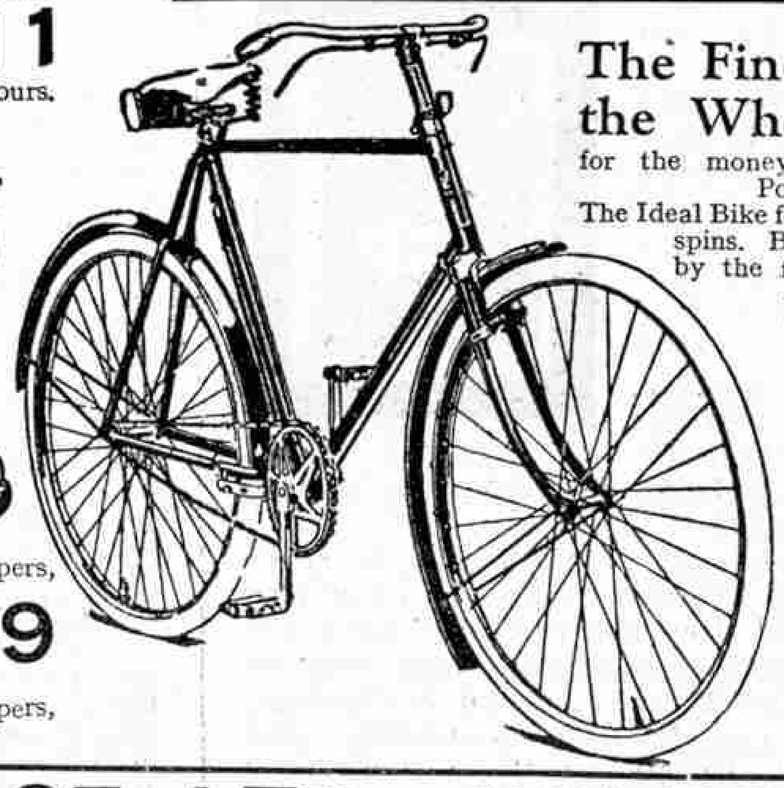

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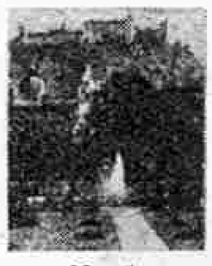
Have You Seen the World?

Sixth Stamp Competition

I WONDER if stamp collectors realise what a wonderful picture gallery of foreign scenes is to be found within the pages of their stamp albums. A year or so ago we took you round the world of stamps, in the "Stamp Tour Round the World," in an endeavour to bring before you some of the views that are to be found on stamps. In that tour we described over a hundred views, visited every continent and most civilised countries, and judging by the popularity of the series our readers were pleased to learn something about the picture-stamps in their possession.



No. 1

The competition this month is designed to test the memory of our readers for views they have seen pictured on stamps, and consists of twelve views cut from twelve different stamps selected from all parts of the world. Competitors are required to give the name of the country of origin of each of the stamps from which the views have been cut, and to the senders of the three most correct lists prizes of stamps chosen from advertisements in this issue to the value of £1-1-0, 10/- and 5/- respectively will be awarded.

No. 4

The closing date for this contest is the 30th of April and as usual the assistance of catalogues and stamp albums is permitted but no other assistance is allowable. Arrange your list of countries in column form numbered one to twelve to correspond with the numbers under the views on this page, add your name and address and do not forget to enclose the list of stamps you wish to be sent to you in the event of you being one of the prize-winners.

We all know how thrilling it is when we visit a strange town, after having looked through an illustrated guide to it, to recognise the various beauty-spots, streets, buildings, and so on as though they were not strangers to us but friends whom we have met before, although actually we have only seen their pictures in black and white on a flat sheet of white paper. Much the same thrill goes through one when a visit is made to some scene that is familiar through the pages of our albums, and ever after the stamp bearing the view we have seen seems to us to mean more, to be a friend, to be a more treasured possession.

No. 7

Who would not have wished to have seen the magnificent, tremendous waterfall shown on stamp No. 3 on this page? or the smaller, broader fall that is seen on No. 6? This one, by the way, reminds the writer every time he sees it of the Swallow Falls at Bettws-y-Coed, North Wales, from their most popular view-point. But if you do not particularly fancy waterfalls, there are views of all kinds to be found on this page alone, which contains only twelve selected from the hundreds to be found in the album. Do you like large buildings, then look at numbers 10 and 11, or perhaps you prefer smaller ones surrounded with own walls as in number 2, "standing in its own grounds" as the house agents say. If you like none of these, then there is what seems to be a castle on a hill in number 1, and one on a cliff by the sea in number 9. We have no hesitation in telling our readers that view number 5 cannot be found within these islands nor anything like it, and except in the depths of a really cold, snowy winter, we have nothing to compare with the massive beauty and solitude of view number 8. Numbers 7 and 12 are more British in type but they are not to be reached without going through the procedure of passports, nor is number 4 with its two shadow-like mountains behind.

No. 2

No. 3

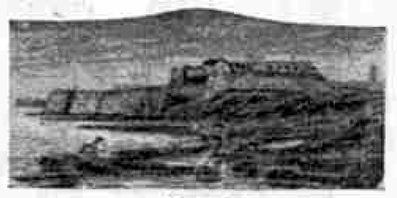
No. 5

We are tempted to offer as the reward in this competition this month a free visit to these twelve places so attractively pictured on these twelve stamps but we check ourselves in time. To visit these places would entail a tour round the world and if we took any of our readers from their homes for the time required to do this thoroughly we should doubtless meet with objections from those who rule our readers' lives. No, let the rewards remain as they have been set out above; they will keep you at home and at the same time enable you to enlarge your stamp picture-gallery. Set to work now and locate the whereabouts of these twelve items.

No. 6

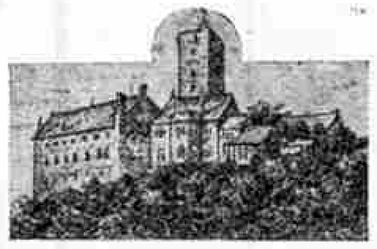
No. 8

Certain of the pictures afford clues that should lead to a speedy identification of the stamps from which the view is taken; others probably will not so readily render up their secret; but the task will reveal a very fascinating side of stamp collecting.

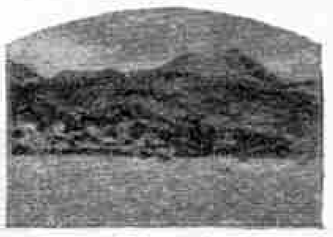


No. 9

One of the most interesting features of the hobby is the facility that is afforded to those who wish to specialise, to follow up almost any subject that can be called to mind. Taking only the twelve stamps depicted on this page, we find at least three distinct "signposts to specialisation." Nos. 3 and 6 might well form the nucleus of a waterfall collection; Nos. 4, 8 and 12 would start a collection of mountains, while 4, 9 and 12 provide a good foundation for an album of really interesting seascapes.



No. 11

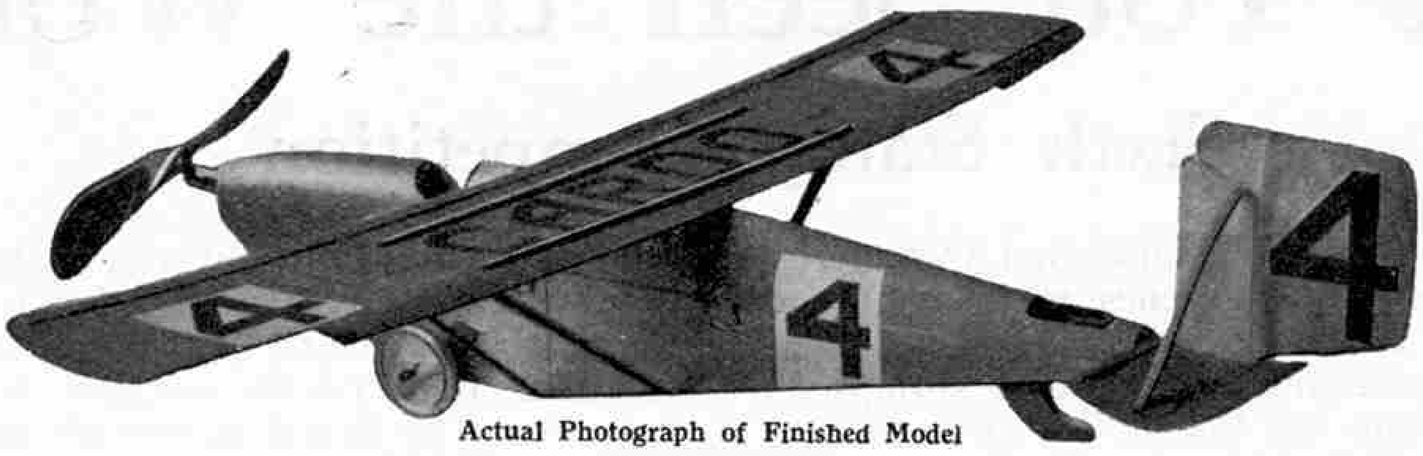


No. 12

No. 10

BOYS! MAKE YOUR OWN AEROPLANE!

LENGTH
19 ins.



Actual Photograph of Finished Model

SPAN
21 ins.

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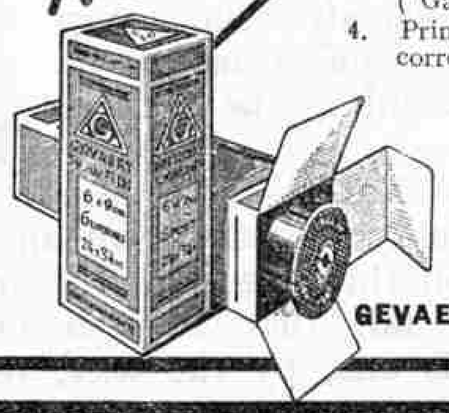

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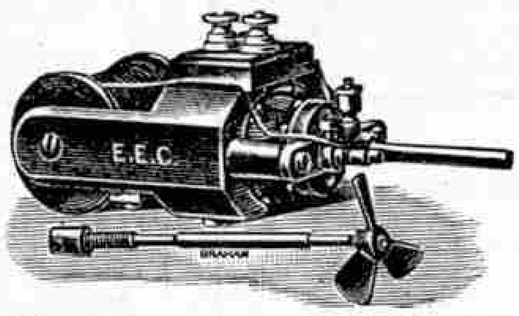

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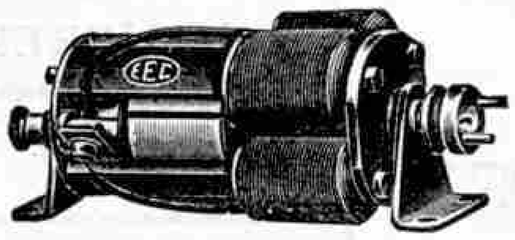

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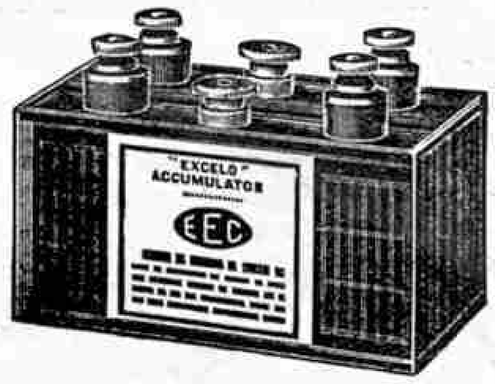

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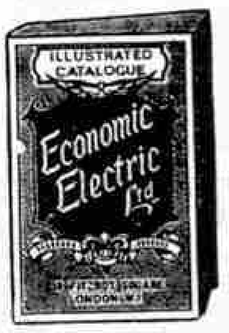

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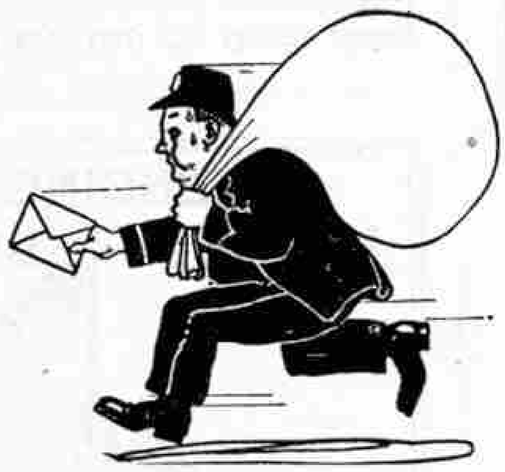

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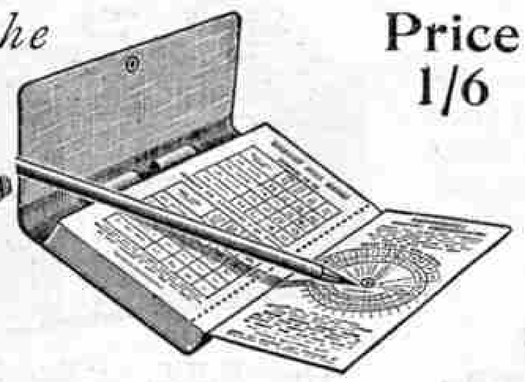

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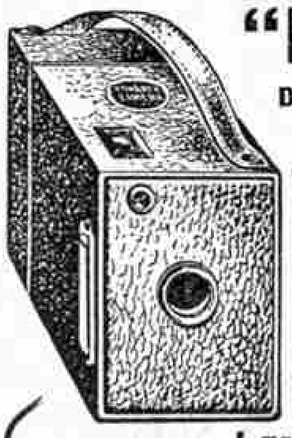

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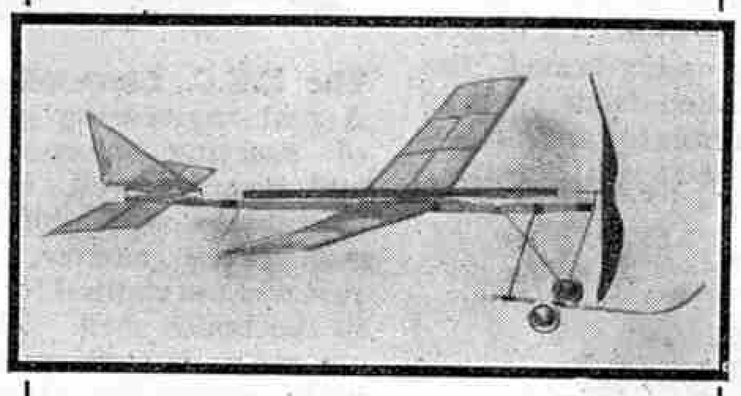

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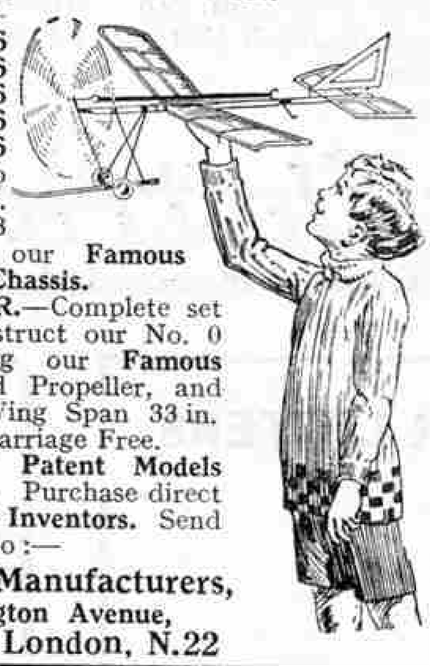

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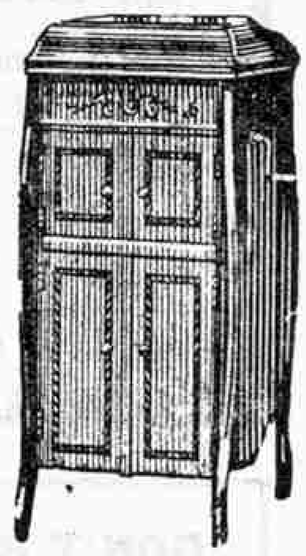

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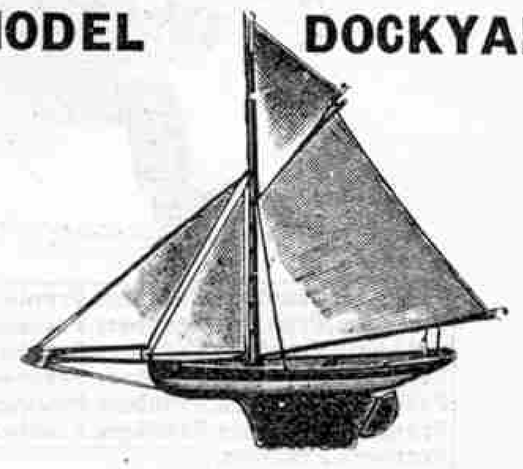

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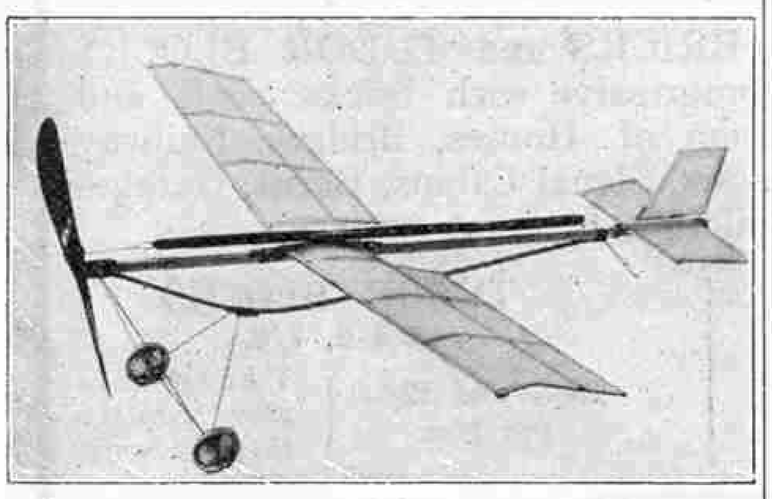

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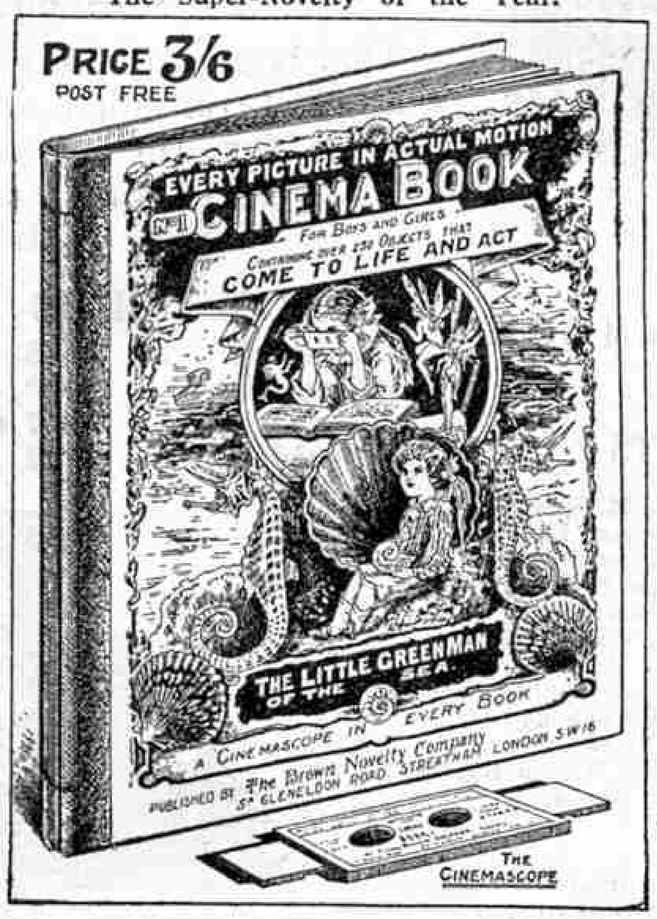

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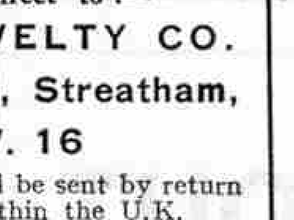

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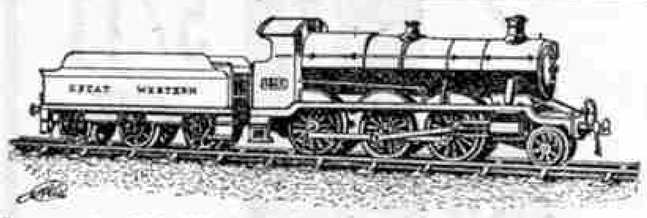

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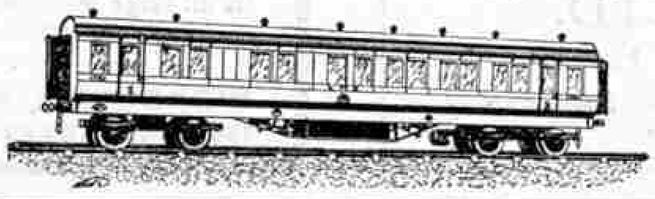

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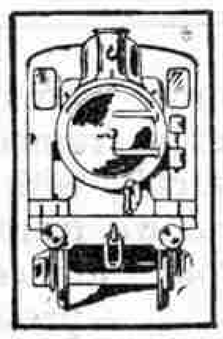

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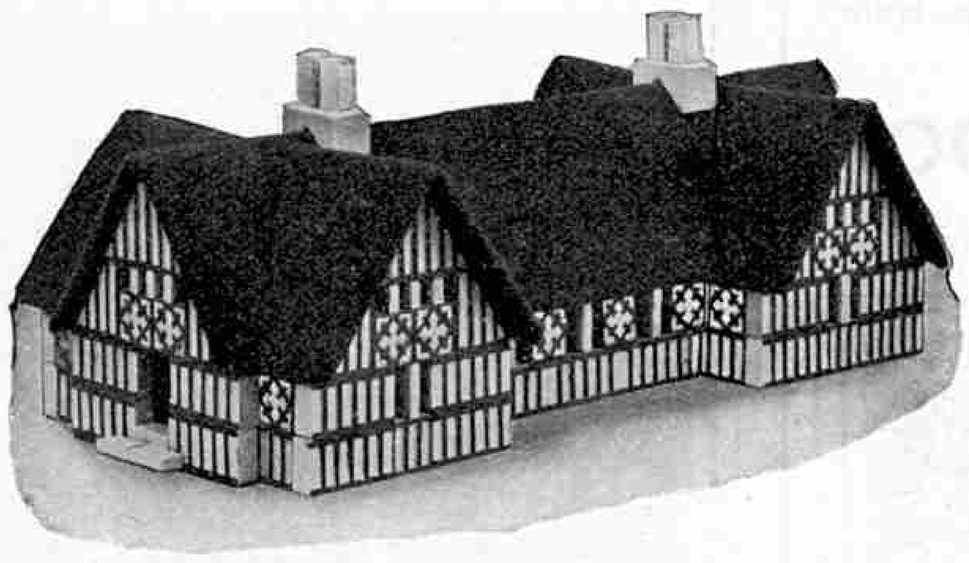

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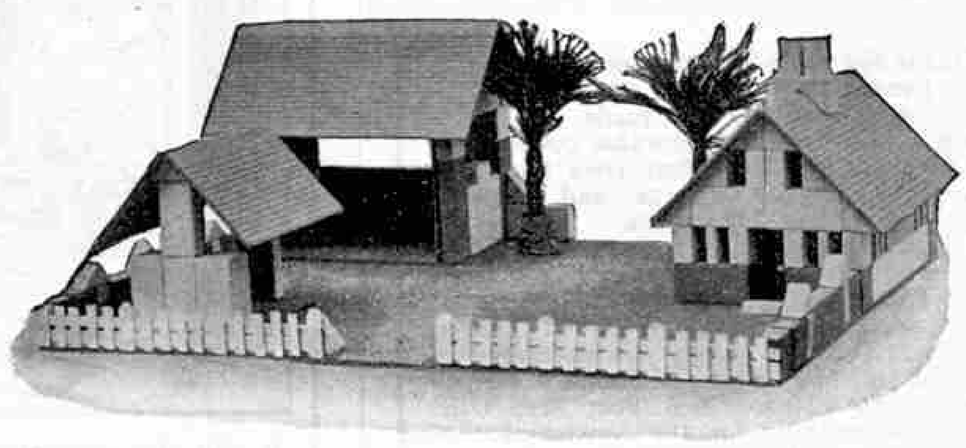

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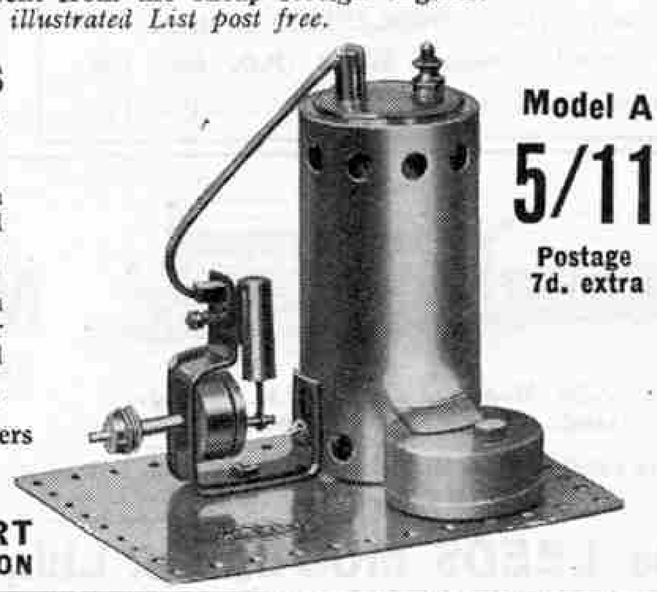

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The sixteen dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

H. WILES LTD.,
124, Market Street,
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R. MARSDEN & SON LTD.,
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ROCHDALE.

ROCHESTER.
GERALD MORRIS,
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SHEFFIELD PHOTO COMPANY,
6, Norfolk Row (Fargate),
'Phone 3891 **SHEFFIELD.**

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Tel. 489 **SHEFFIELD.**

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OSBORN & CO.,
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SOUTHAMPTON.

S. T. SIMPSON & SON,
589-595, Lord Street,
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H. W. GINN,
The London Motor, Cycle & Sports Co.,
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SPORTS HOUSE **WOKING & WEYBRIDGE.**

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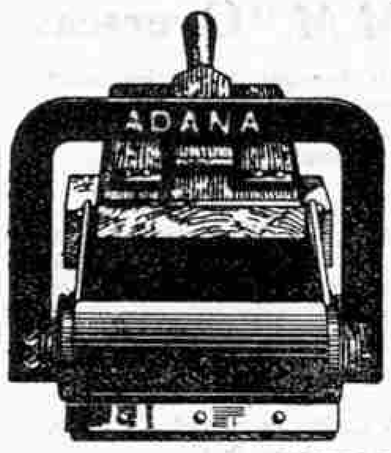

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COMPLETE PLANT

This massively constructed Printing Machine is the most wonderful of its kind. There are now over 10,000 users of these plants, many saving enormously in their own work, others making an excellent living. Will print any class of matter

FROM A CHEMIST'S LABEL TO AN ILLUSTRATED MAGAZINE

including Perforating, Creasing and Box-making. The finest malleable iron and mild steel used in construction. Simplicity to the extreme. No special skill required. Large numbers of boys are producing their School and Scout Magazines. Printers' metal type, case, complete accessories, and excellently illustrated instructional book included. Illus. particulars in two colours, and samples of work, sent on receipt of stamped addressed envelope. Also sold by small weekly instalments. Ask for Terms.

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Printers should write for particulars of new system of supplying First-Class Founders' Type.

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FORGET TYRE TROUBLE

and go care - free on your way. Tubes treated with our IMPERVO increase the joys of your Cycle.

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FREE

to Meccano Readers.
Write NOW for a Copy.

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OF MEMBERS' WORK

Kingsway Hall, Kingsway, W.C.1.

Tues., April 19th to Sat., April 23rd.

11 a.m. to 10 p.m.

ADMISSION :

ADULTS 1/2. (Including Tax) **CHILDREN 6d.** (under 11)

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OPEN COMPETITION
for 1 gauge (1¾in.) Steam Locomotives,
Apply to the Hon. Sec.: R. HENVEY,
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Service your tyres give you.
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Distance travelled, etc.

Make your riding doubly interesting. Its accuracy has been endorsed by all the best authorities and the experience of your fathers for 30 years.

Insist upon a genuine Veeder—see the name thereon.

Made in Two Models:
Regular 6/6, Trip 15/-.

F. E. DICKINSON,
ST. ANDREW'S HOUSE, HOLBORN CIRCUS,
LONDON, E.C. 1.

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Catalogue Post Free. J. G. Graves Ltd. Sheffield.

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Valuable Collection, 1,250 Stamps in Album. £2, nearest offer. Particulars.—H. Phelps, Maiden Bradley, Bath.

" Meccano Magazines," July 1924 to January 1927, sale, offers.—Smith, 32, Tivoli Street, Cheltenham.

For Sale. King Air Gun, Engine, Tender, 3 Carriages, No. 3 gauge, Crystal Set complete, offers.—A. Daniell, Hursley Hill, Whitchurch, Bristol.

Wanted. " Meccano Magazine," February, 1926. 1/6 offered.—Russell, 4, Clifton Villas, Herne Bay.

Steam Locomotive, two Bogie Coaches, 8 Rails, gauge 0, also Horizontal Steam Engine, half cost price. Write for particulars.—Parker, " Moyana," Burdon Lane, Cheam.

Gauge 0 Clockwork Locos for sale. Also Steel Rails and Points. Stamp for particulars.—Stephen, The Manse, Inverkeithing, Fife.

Exchange Stamps, your country for mine.—Master Pearson, Norton St., Ballina, Australia.

Collection 1,400 Stamps. Catalogued over £8. Sell 30/-.—Brighting, 77, Leyspring Road, Leytonstone.

Sale. 100 Boys' Papers, Stamp Album and Catalogue. Write for particulars.—Bedford, " Hillsboro," Llamshen, Cardiff.

" Vertical " Steam Engine, works well; usual fittings, fixed cylinder, 10/6. Primus, Sets 1, 1s, 15/-.—P., 119, Coniston Road, Bromley, Kent.

For Sale.—Meccano Magazines, from Dec. 1923 to March 1927. Also Air Gun, new at Xmas. Best offer.—G. Harcourt, 6, Upper Avon St., Evesham.

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For Sale. Cinematograph, Electric Motor, Models, Stamps, and many other bargains. Send ½d. stamp for list.—R. Blake, The Gables, 145, Marlborough Road, Coventry.

For Sale. Microphone Transmitter Button. Perfectly new. Cost 4/9. Accept 2/6. Write—B. A. Shattock, St. Mark's Vicarage, Purley.

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Cigarette Cards, Bought, Sold, and Exchanged. Lists—Thornton, 159, Grosvenor Road, Wavertree, Liverpool.

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Spanish Model Ukelele and Case, cost 20/-, as new, accept 10/-. Stationary Steam Engine, cost 27/6, accept 10/-.—Mayhall, Horsforth, Leeds.

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" Meccano Magazines," Jan. 1921 to Dec. 1926, to Dec. 1925 6d., any 1926 4d., or offer for lot, all perfect.—Stanway, Baden Terrace, Cleckheaton.

For Sale. Miniature Railway, almost new. Cost 18/-. Take 10/-.—Weston, 17, Waverley Avenue, Exeter.

For Sale. Bassett-Lowke L.M.S. 2-6-0 Steam Engine, Gauge 0, £2/15/- or offers.—H. Radcliffe, Alderbury, Salisbury.

Parting with Stamp Collection. Will sell in cheap lots. Cigarette Cards, 4d. 100. Particulars Free.—Box 402.

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SMALL ADVERTISEMENTS

(Rate: 1/- per line)

IRON CEMENT, 1/3, 2/6, 4/6, post paid.—Albert Feather, White Abbey Road, Bradford, Yorkshire.

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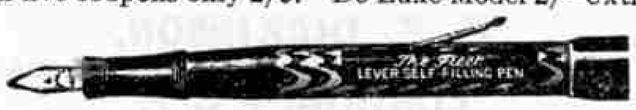

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICES :—
BINNS ROAD, LIVERPOOL.

Telegrams : " Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price **6d.** per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept any responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Advertisements

Readers' Sales and Wants. Private advertisements (*i.e.*, not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper.

Small Advertisements. 1/- per line (average seven words to the line), or 10/- per inch (average 12 lines to the inch). Cash with order.

Display. Quotations for space bookings, and latest circulation figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 10th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking two inches or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Obtaining the "*M.M.*" Overseas

Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office, the price and subscription rates being as above.

IMPORTANT.

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

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NEW ZEALAND : Messrs. Browning, Ifwersen Ltd., P.O. Box 129, Auckland.
SOUTH AFRICA : Mr. A. E. Harris (P.O. Box 1199), Textile House, Von Brandis St., Johannesburg.

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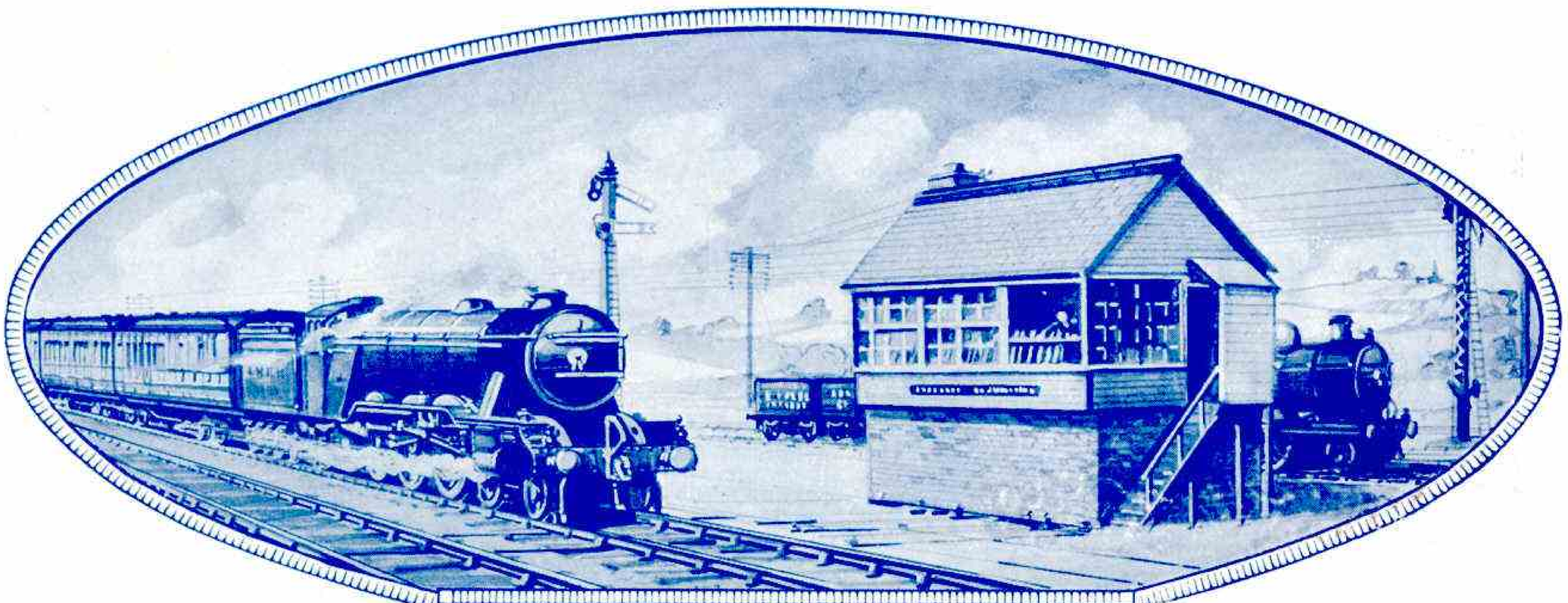
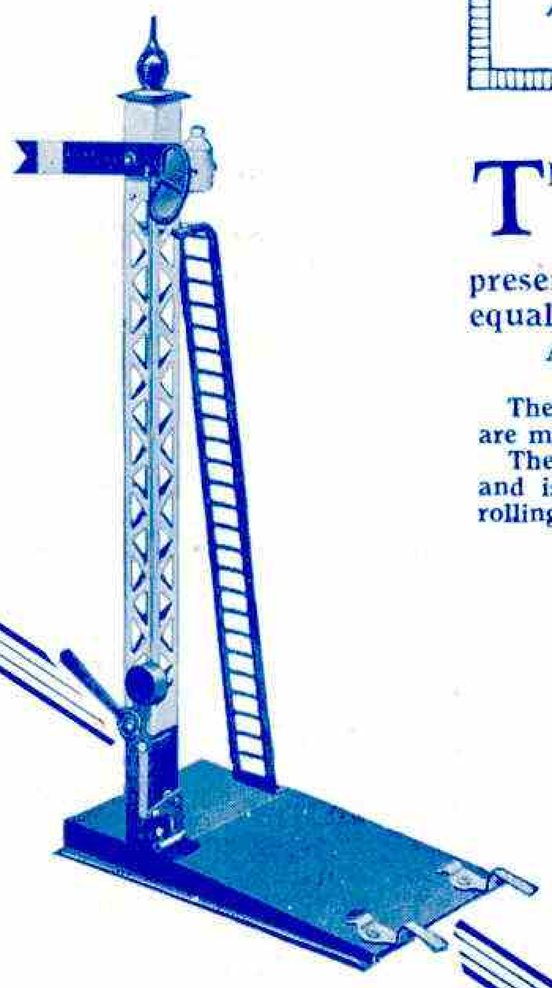


SIGNALS AND POINTS CONTROLLED, AND TRAINS STARTED, STOPPED AND REVERSED FROM THE SIGNAL CABIN



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* The loco in each case is fitted with a special cam which is operated by a Hornby Control Rail. This rail is included in all these train sets and locos.

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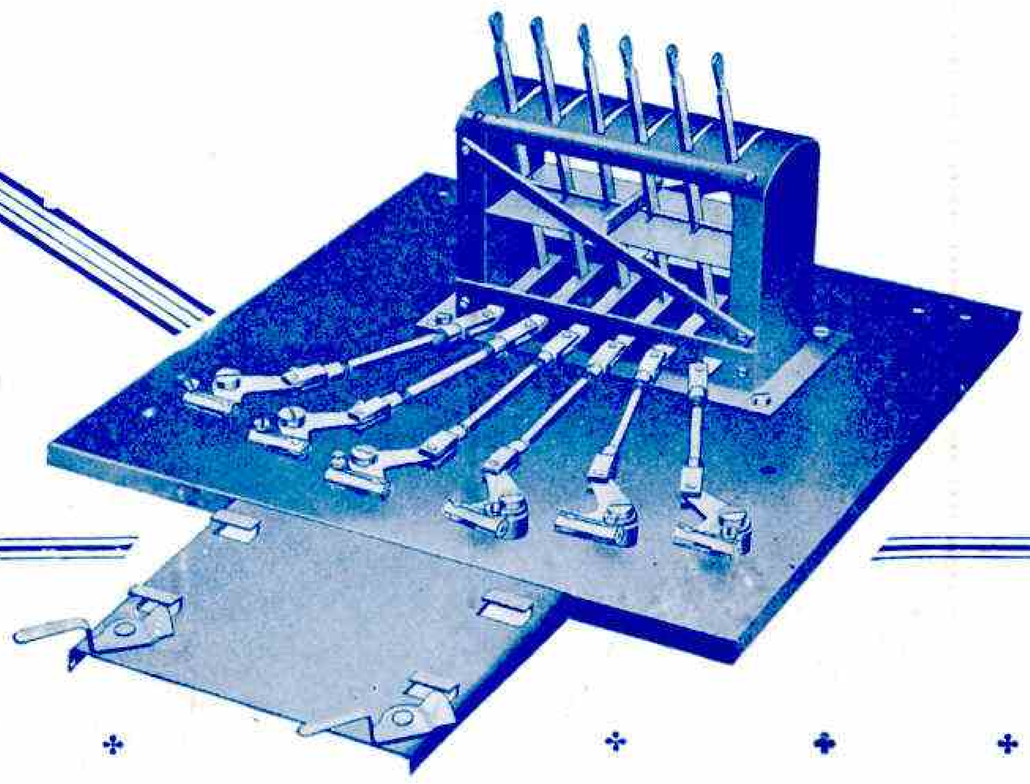

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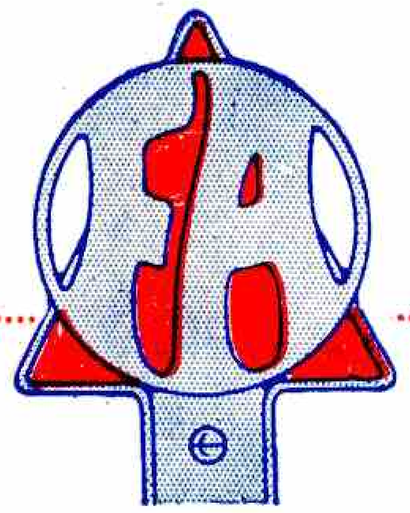

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